A Preliminary Classification of Riparian Vegetation Types of the Medicine Bow Range and the Sierra Madre

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INTRODUCTION

In June of 1990, the staff of the Medicine Bow National Forest (U.S. Department of Agriculture Forest Service) and The Nature Conservancy entered into a challenge cost-share agreement to study riparian vegetation on selected streams in the Medicine Bow National Forest of southeastern Wyoming. The goals of the agreement were to (1) produce a preliminary classification of riparian vegetation types, including a description of the composition and structure of the vegetation, the physical environment of each vegetation type, and the historical use of each stand studied; (2) interpret, as far as the data allowed, the relationship between vegetation and physical environment; and (3) interpret, as far as the data allowed, vegetation dynamics.

Potential sampling sites were located in late June and early July, 1990 along the following five streams in the Sierra Madre (the Hayden Ranger District): Battle Creek, Big Sandstone Creek, North Soldier Creek, Beaver Dam Park, and Big Creek (Figure 1). All sites on these streams were below 9500 feet elevation. Potential sampling sites also were located along two streams in the Medicine Bow Range (Figure 1), those being the Medicine Bow River (in the Brush Creek Ranger District) and Rock Creek (in the Laramie Ranger District). The sampling sites in the Medicine Bow Range were at elevations between 9000 and 10,000 feet. These sites were visited again during July, August, and September 1990, and information on species composition and vegetation structure and on physical environment was collected from 50 plots (one or more plots representing a stand of vegetation). Plant specimens were also collected from each plot.

The plot data were analyzed to identify groups of stands with similar vegetation -- that is, to identify vegetation types. These groups were then compared to published descriptions of riparian plant communities from Wyoming, Montana, Utah, and Colorado. These published descriptions contain information on vegetation dynamics and on management of riparian vegetation types. Comparing the vegetation types identified from the plot data with those described in the literature allows one to take advantage of this information on ecology and management of riparian vegetation.

METHODS

DATA COLLECTION

Data on canopy cover were collected from stands along five streams in the Sierra Madre and the two streams in the Medicine Bow Range. Biologists from the Medicine Bow National Forest staff and the Wyoming Natural Diversity Database walked the length of each stream in June and early July 1990, to identify

stands of vegetation for sampling. WYNDD biologists returned to the streams in July, August, and September 1990 to collect data.

A sample plot was marked out for data collection in each stand. The plot was large enough to represent the vegetation and environment of the stand and small enough to avoid edges of the stand. Plots ranged in size from 100 m^2 to 400 m^2. The canopy cover of each vascular plant species in five categories (overstory tree; tall shrub and sapling over 1.5 meters tall; medium-height shrub and seedling 25 cm to 1.5 meters tall; low shrub <25 cm tall; and herbaceous) in the plot was estimated and scored into one of 10 cover classes, using a modification of the Daubenmire canopy cover-class method (Daubenmire, 1959). Ground cover in the plot was estimated to the nearest percent for 6 categories: bare soil (particles with longest dimension < 1/16 inch), gravel (particles with longest dimension 1/16 inch to 3 inches), rock (particles with longest dimension > 3 inches), litter (dead plant material < 1/4 inch thick, lying on ground), wood (dead plant material ≥ 1/4 thick, lying on ground), and moss (bryophytes and lichens). The vascular plant species present in the stand but outside the plot were listed, and specimens were collected for later identification at the Rocky Mountain Herbarium, University of Wyoming, Laramie, WY. Specimens were deposited in the Rocky Mountain Herbarium. The number of trees in the plot was recorded by species, and the diameter of each tree was measured at approximately 1.4 meters above the ground.

Selected physical environmental factors were characterized for the stand by estimating the distance from the plot to the nearest stream channel, and the height of the plot above the stream channel. (The channel was defined as that part of the stream below the lowest perennial terrestrial vegetation.) Signs of disturbance (flooding, roads, tree cutting, grazing, beaver dams) in the stand were noted, and the location of the stand was marked on a 1:24,000 scale topographic map.

For each stand, the width of the valley bottom in the area of the stand was estimated in the office from the 1:24,000 scale topographic map with the following procedure: the first topographic line intersecting the stream upstream from the stand and the first topographic line intersecting the stream downstream from the stand were noted, and the midpoint of the distance along the stream between those two topographic lines was marked on the map. At that midpoint, the distance across the valley between the lowest topographic line on each side of the stream was measured, and this distance between topographic lines was considered an estimate of the width of the valley bottom. This procedure gives an approximate measure of valley bottom width, and allows comparison of the valley width from stand to stand.

Sinuousity of the stream [(stream length/valley length) x 100] near each stand was also calculated in the office from a

200% photocopy enlargement of the 1:24,000 scale topographic map. A stretch of the stream valley including the stand, and uniform upstream and downstream from the stand for gradient and stream sinuousity, was marked on the enlargement of the map. The length of the valley stretch and the length of the stream channel in that valley stretch were measured with a plan measure (a map wheel), and the sinuousity calculated from those lengths. Gradient of the valley floor [(change in elevation/length of valley stretch) x 100] was also calculated for that stretch of the stream valley. The stretches of stream valley used for stream sinuousity and valley gradient measurements were 1/4 mile to approximately 1 mile long, and stretches commonly contained more than one stand. Consequently, different stands have the same values for stream sinuousity and valley gradient.

DATA ANALYSIS

Data were collected from 50 sampling plots in 44 stands, and about 275 vascular plant species were identified. Twenty-five of the plant species that occurred in small amounts in only one or two stands were eliminated from the data analysis; tables in this report include the remaining 250 species.

The canopy cover data were analyzed initially with two-way indicator species analysis (TWINSPAN) in the PC-ORD package (McCune, 1991) to identify groups of plots (and, therefore, groups of stands) similar in the amount of each plant species present. Cover values were relativized before analysis by dividing the cover value for each species in a stand by the total cover for all species in the stand. The data set was reduced after cover values were relativized by removal of three groups of species: (1) species that occurred in less than 4 stands, (2) species that contributed < 1 % relative cover in any stand, and (3) seven widespread and common species (Phleum pratense, meadow timothy; Poa pratensis, Kentucky bluegrass; Cirsium arvense, Canada thistle; Taraxacum officinale, common dandelion; Trifolium pratense, red clover; Carex spp., unidentified sedge species; and Achillea millefolium, western yarrow). Removal of these species left the species that contributed substantial amounts of cover to limited numbers of plots.

The reduced data set was also analyzed with cluster analysis in the PC-ORD package. Cluster analysis is a classification program that produces groups of similar plots using a different mathematical approach than TWINSPAN, but the two analysis programs produced similar groups of species. Finally, the data were analyzed with the Bray-Curtis ordination program in PC-ORD, to see how stands that the classification programs could not place in any group related to the groups of stands. (Ordination is a method of analysis useful for identifying gradients in similarity of vegetation between stands. It therefore differs from classification, the point of which is to produce groups of

stands based on similarity.) Some of the stands that the classification programs could not readily place into groups were then assigned to groups subjectively based on the results of the ordination.

The groups of species identified by the classification and ordination analyses were compared to published descriptions of riparian plant communities from the northern and central Rocky Mountains and the northern Great Plains.

THE CLASSIFICATION

The classification is a hierarchy of vegetation types with these three levels (Figure 2):

Physiognomic classes: vegetation types identified by the growth form of the tallest layer -- conifer class, deciduous tree class, tall shrub class, etc.

Series: vegetation types within a class identified by the dominant species or a characteristic species in the tallest layer -- narrowleaf cottonwood series, Booth willow series, beaked sedge series, etc.

Community: vegetation types within a series identified by the dominant or characteristic overstory and understory species -- narrowleaf cottonwood/Kentucky bluegrass community, Booth willow/beaked sedge community, beaked sedge community, etc.

Physiognomic classes are the broadest vegetation units, and each class generally contains at least two series (Figure 2). Most series, in turn, contain communities, which are the most detailed vegetation units described in this classication.

DESCRIPTIONS OF VEGETATION TYPES

CONIFER PHYSIOGNOMIC CLASS

Picea engelmannii Series

This series includes stands with tree canopies in which Engelmann spruce is the major tree. One community was identifed.

Picea engelmannii/Galium triflorum Community

Occurrence

Three stands of vegetation with Picea engelmannii (Engelmann spruce) overstory trees were sampled, with one 10 m x 10 m plot per stand. Two of the stands were on North Soldier Creek, and one was at Beaver Dam Park (Table 1). All three stands were above 8500 feet elevation (Figure 3) along straight streams (Figure 6). This community occurs in wide valleys and narrow valleys (Figure 4), and valley gradient can vary from nearly flat to almost 8% (Figure 5). The plots representing the three stands were all immediately next to the stream channel (Figure 7), and were within about half a meter above the channel (Figure 8).

Vegetation

The composition of the tree overstory varied between plots, from mainly Engelmann spruce saplings and poles with a few small spruce trees (Figure II-1); to a mix of small Engelmann spruce, subalpine fir, and lodgepole pines (Figure II-2); to a few Engelmann spruce trees with numerous subalpine fir in the subcanopy (Figure II-3). In all stands, Engelmann spruce dominated or codominated the canopy by cover (Table I-1). Tall and medium-height shrubs were nearly lacking (Table I-1).

The understories in the three plots were mixtures of Vaccinium scoparium (grouse whortleberry) with small amounts of various graminoids and forbs. Senecio triangularis (arrowleaf groundsel), Caltha leptosepala (elkslip marshmarigold), Carex rostrata (beaked sedge), Glyceria striata (fowl mannagrass), Equisetum laevigatum (smooth horsetail), Galium trifidum (small bedstraw), Mitella pentandra (fivestamen mitrewort), and Saxifraga odontoloma (brook saxifrage) indicate wet sites. The dominance by Vaccinium suggests a drier site but, as Youngblood et al. (1985) note in their discussion of western Wyoming riparian communities, the Vaccinium in riparian zones usually is restricted to hummocks.

Relationship to other studies

Understories in the three Sierra Madre Engelmann spruce stands are similar to the understory described by Youngblood et al. (1985) for the Picea/Galium triflorum community type of western Wyoming. Youngblood et al. did not assign a species epithet for spruce in naming that community type, because they considered P. engelmannii and P. pungens to be similar ecologically in western Wyoming. In contrast, Picea engelmannii and P. pungens occurred in distinctly different stands in the present study. Galium triflorum apparently is lacking from these three Sierra Madre stands and G. trifidum is present, but the presence of the other wet-site forbs indicates a close similarity

to the western Wyoming Picea/Galium triflorum community. Consequently, these three stands are assigned to the Picea engelmannii/Galium triflorum community. Steele et al. (1983) describe a Picea engelmannii/Galium triflorum habitat type from western Wyoming, with vegetation similar to these three Sierra Madre stands. Johnston (1987) lists a Picea engelmannii-Picea pungens/Galium triflorum plant association (based in part on Steele et al., 1983) from the USFS Region 2. The Picea engelmannii-Abies lasiocarpa/Senecio triangularis habitat type described from the Arapaho and Roosevelt National Forests of Colorado (Wasser and Hess, 1982) supports vegetation somewhat similar to the Sierra Madre riparian Picea engelmannii stands, but that Colorado habitat type occurs on very high elevation, upland sites, not riparian sites. The habitat type publications for the Medicine Bow National Forest (Alexander et al., 1986) and the nearby Routt National Forest of Colorado (Hoffman and Alexander, 1980) do not describe riparian habitat types or vegetation types similar to the Picea engelmannii/Galium triflorum community.

Succession/Management

Youngblood et al. (1985) suggest that vegetation and soils in stands of the Picea engelmannii/Galium triflorum community are relatively stable, and that this community is the climax vegetation for the Picea engelmannii/Galium triflorum habitat type. According to their study, this vegetation in western Wyoming develops rapidly on "protected sites", while sites on exposed benches and along steep streams may support intermediate vegetation types (specifically, the Cornus stolonifera/Galium triflorum or Picea/Cornus stolonifera community types).

According to Steele et al. (1983), limited data from the Picea engelmannii/Galium triflorum habitat type in western Wyoming suggest that timber productivity ranges from moderate to very high, but the locations of stands along streams and the high water tables may restrict timber harvest. These site factors may make protection of water and soil resources the prime goals in management.

Other notes

Exotic plants accounted for little cover in the three stands of Picea engelmannii/Galium triflorum vegetation sampled in this study (Table I-1). Taraxacum officinale was present in all three stands, but only one of the stands contained enough Poa pratensis or Phleum pratense to be sampled in the plots.

This vegetation type probably is more common than the sample size indicates. Many of the high-elevation streams in the Sierra Madre and Medicine Bow Range have Picea engelmannii-dominated riparian vegetation, and much of that vegetation may be the Picea engelmannii/Galium triflorum community. The low number of

samples results from the emphasis in this study on relatively low-elevation streams.

Picea pungens Series

This series includes stands with tree canopies in which blue spruce is the major tree. No communities were identified in this series.

Occurrence

Data were collected from two 10 m x 10 m plots in Picea pungens (blue spruce) woodland along the North Fork of Big Creek, at the west end of Cunningham Park (Table 2). (These plots were close enough together that they might best be considered as being in the same stand.) The plots were at an elevation of 8080 feet -- the middle of the range of elevations of all plots sampled (Figure 3) -- in a narrow valley (Figure 4) with a fairly gentle gradient (Figure 5). The section of the North Fork of Big Creek along the plots is nearly straight (Figure 6). Both plots were within several meters of the stream channel (Figure 7), and were half a meter above the channel (Figure 8).

Vegetation

Picea pungens and Pinus contorta (lodgepole pine) formed the tree overstory in both plots (Table I-1). Both plots were in parts of the stand with fairly low tree density. Plot 511 included slightly more small lodgepole pines than blue spruce (Figure II-4), while plot 521 included only one large blue spruce and several small pines and subalpine fir (Abies lasiocarpa) (Figure II-5). The presence of the lodgepole pines in the overstory probably is due to the location of the stand in a narrow valley, where the riparian zone and the upland are close together.

Both blue spruce plots had considerable tall shrub cover, with Alnus incana and willow forming the tall shrub layer in one plot and a mix of willows forming the tall shrub layer in the other plot (Table I-1). Several species formed a sparse medium-height shrub layer in each plot.

The herbaceous understory was fairly sparse in each plot (Table I-1). Unidentified sedges, Geranium richardsonii, Maianthemum stellatum, Osmorhiza spp., and Taraxacum officinale contributed more than 1% cover in each plot. Equisetum laevigatum, Frasera speciosa, and Orthilia secunda were present in substantial amounts in one plot. Numerous other graminoids and forbs were present in one or both plots in small amounts.

Relationship to other studies

Johnston (1987) lists a Picea pungens/Alnus incana plant association from western Wyoming, the Routt National Forest of north-central Colorado, and other parts of Colorado and New Mexico. He does not describe the vegetation from this plant association, but it resembles the Sierra Madre stand closely in the list of species present and the riparian site it occupies. Wasser and Hess (1982) and Hess and Alexander (1986) describe riparian vegetation from the Roosevelt National Forest in the Colorado Front Range, which they use to identify the Picea pungens/Arnica cordifolia habitat type. The Roosevelt Forest vegetation resembles the stand sampled in the present study, in having Picea pungens well-represented in the tree layer, Juniperus communis and Rosa woodsii in the shrub stratum, and Osmorhiza depauperata and Smilacina stellata (=Maianthemum stellatum) in the understory. The stands they studied differed markedly from the Sierra Madre stand, though, in that their stands apparently lacked Alnus incana in the shrub layer and had Arnica cordifolia as a strong understory dominant. Wasser and Hess (1982) also describe riparian vegetation with a tree layer dominated by blue spruce from the Picea pungens/Amelanchier alnifolia-Cornus stolonifera/Carex geyeri habitat type on the White River National Forest of west-central Colorado. The Sierra Madre stand, though, lacks Amelanchier alnifolia and Cornus sericea (=C. stolonifera) in the the shrub layer and apparently also differs substantially in understory composition from the Colorado vegetation. Hoffman and Alexander (1983) describe a Picea pungens/Poa spp. habitat type supporting blue spruce woodlands in the White River National Forest of west-central Colorado, but that vegetation (and the habitat type) are clearly on uplands, not in riparian zones. Steele et al. (1983) note that Picea pungens woodlands grow along rivers and large streams in northwestern Wyoming, but do not describe vegetation types or habitat types from that area.

The single stand of blue spruce sampled in the present study suggests that riparian vegetation dominated by Picea pungens occurs along some streams in the Medicine Bow National Forest, but the information from that stand is insufficient to identify a new Picea pungens community type or to associate the stand with blue spruce vegetation types identified in other studies. Data from other stands may show that the Picea pungens/Alnus incana plant association of Johnston (1987) occurs in the Forest.

Succession/Management

Good conclusions on appropriate management of the Picea pungens series must await more information on the composition and environment of this vegetation type. Information on management of vegetation on the Picea pungens/Arnica cordifolia habitat in the Roosevelt National Forest (Hess and Alexander, 1986) may be useful, though. Hess and Alexander (1986) suggest that the primary value of that habitat type is for recreation, and

providing food and cover for wildlife. The habitat type may be suitable for light timber harvest, but Hess and Alexander point out that the danger of soil compaction and the possibility of rising water tables following removal of trees precludes extensive logging. Livestock use must also be limited, to avoid soil disturbance.

Other notes

The plot data suggest that exotic plants were minor components of the vegetation in the Picea pungens stand.

DECIDUOUS TREE PHYSIOGNOMIC CLASS

Populus angustifolia Series

This series includes stands with tree canopies in which narrowleaf cottonwood contributes as much cover as, or more cover than, other trees.

Populus angustifolia/Poa pratensis Community

Occurrence

Data were collected in six stands of Populus angustifolia (narrow-leaf cottonwood) trees, with one plot measuring 200 m^2 or 400 m^2 in each stand (Table 3). All six stands were at relatively low elevation (Figure 3) in the moderately-wide, low-gradient valleys of Battle Creek and Big Sandstone Creek (Figures 4 and 5). Battle Creek in the vicinity of the Populus angustifolia stands is relatively straight, while Big Sandstone Creek is quite sinuous (Figure 6). The variation in distance from plot to stream channel (Figure 7) indicates that the cottonwood stands grow over a range of distances from the stream, and they grow on surfaces up to nearly 1.5 meters above the channel (Figure 8).

Vegetation

Populus angustifolia was essentially the only tree present in all but one plot (Table I-2), indicating the strong dominance of the tree stratum by cottonwood. The size-class structure of the cottonwood population in the stands studied typically was a preponderance of small or medium-sized trees with a cohort of seedlings (Figures III-6, III-8, III-9, and III-10). One of the Big Sandstone Creek stands had a tree stratum of about equal numbers of small, medium-sized, and large trees (Figure II-11), and one of the Battle Creek stands had a tree stratum of medium-sized cottonwoods with Picea pungens poles and small trees (Figure II-6). The concentration of cottonwood trees in one or two size classes results from the mode of establishment of the cottonwoods: seedlings become established on newly-deposited

bars and islands, and the closing of the tree canopy prevents further establishment of cottonwoods (Hansen, Boggs, et al., 1991).

A variety of tall and medium-height shrubs occurred in the cottonwood stands (Table I-2), but shrub cover was sparse in four of six stands. In one of the stands with substantial shrub cover, represented by plot 132, Salix boothii formed an open tall shrub layer and the Populus angustifolia overstory was less dense than in the other stands. In the other stand with substantial shrub cover, represented by plot 121, Juniperus communis contributed substantial cover beneath the mixed cottonwood/blue spruce overstory. Alnus incana and Artemisia cana grew in half the stands.

Total graminoid cover in the plots (Table I-2) indicates that five of the six stands had substantial graminoid cover, with the exception being the stand with the mixed narrowleaf cottonwood-blue spruce overstory (plot 121). Total forb cover was at least 10% in all the plots. Every stand contained a large number of graminoid and forb species, but usually in small amounts. Only seven species -- Agropyron subsecundum (= A. trachcaulum in many taxonomic treatments), Bromus anomalus, Carex spp., Juncus balticus, Poa pratensis, Taraxacum officinale, and Vicia americana -- occurred in at least half the stands and contributed substantial cover in at least one stand. Five more species -- Elymus x macounii, Achillea millefolium, Cirsium arvense, Maianthemum stellatum, and Potentilla gracilis -- occurred in at least three stands, but in small amounts. Two species, both exotics, stood out by contributing substantial cover in the most stands: Poa pratensis (Kentucky bluegrass) dominated or codominated the understory in five stands, and Taraxacum officinale (common dandelion) was a major species in three stands.

Relationship to other studies

A Populus angustifolia/Poa pratensis community has been described from western Wyoming and eastern Idaho (Youngblood et al., 1985), Utah (Padgett et al., 1989), and Montana (Hansen, Boggs, et al., 1991). Stand of this community differ from one another somewhat in species composition, but the community is characterized by dominance of the tree stratum by Populus angustifolia, a sparse shrub stratum, and a diverse understory that includes Poa pratensis, Agropyron trachycaulum, Maianthemum stellatum, Osmorhiza spp., and Taraxacum officinale. The plot data from the Sierra Madre stands suggest that these stands can be considered occurrences of this community. The stand represented by plot 121 may be transitional to a Picea pungens type.

Wasser and Hess (1982) and Hess and Alexander (1986) describe a Populus angustifolia/Salix exigua habitat type from

the eastern slopes of the Front Range in Colorado. The stands described by Hess and Alexander (1986) from that habitat type contain more shrub cover and less cover by Kentucky bluegrass and common dandelion than is typical for the Populus angustifolia/Poa pratensis community, and these stands resemble the Populus angustifolia/Cornus sericea (=Cornus stolonifera) community of Youngblood et al. (1983), Padgett et al. (1989), and Hansen, Boggs, et al. (1991).

Succession/Management

Populus angustifolia becomes established on bare substrates after flood, but not on well-vegetated substrates or under tree canopies; hence Populus angustifolia/Poa pratensis stands are seral (Hansen et al., 1988). (The two plots in stands of cottonwood seedlings, described below in the section on the Populus angustifolia Recent Alluvial Bar vegetation type, illustrate the environment necessary for cottonwood establishement.) The future of the vegetation in the Populus angustifolia/Poa pratensis stands depends on whether the sites on which they grow remain stable or are disturbed by floods. If the sites are not flooded, the cottonwoods will eventually disappear and most of the sites will be occupied by herbaceous vegetation (probably dominated by Poa pratensis) or, perhaps, by stands of Artemisia cana (silver sagebrush). If construction of a beaver dam or diversion of water into an overflow channel brings the water table beneath a site closer to the surface, the site may come to be occuppied by vegetation dominated by Carex rostrata (beaked sedge), Carex aquatilis (water sedge), or other wet-site gramninoids. One stand, represented by plot 121, apparently is an exception; the presence of Picea pungens in the overstory indicates that this cottonwood stand will become a blue spruce stand upon the disappearance of the cottonwoods.

Investigations in Montana (Hansen, Boggs, et al., 1991) indicate that stands of the Populus angustifolia/Poa pratensis community are created by grazing, through the removal of a layer of tall shrubs (primarily Salix exigua) and medium-height shrubs (primarily Cornus sericea, Rosa spp., and Symphoricarpos spp.) from the Populus angustifolia/Cornus stolonifera (=Cornus sericea) community. This latter community is similar to the vegetation described by Hess and Alexander (1986) from the Populus angustifolia/Salix exigua habitat type in the Colorado Front Range, and to the P. angustifolia/S. exigua-Betula fontinalis (= B. occidentalis) plant association of Johnston (1987). The Sierra Madre stands contain small amounts of riparian shrubs (Alnus incana, Amelanchier alnifolia, Salix boothii, Salix exigua, Ribes inerme, Rosa woodsii, Rubus idaeus), but the plot data do not indicate the presence of the diagnostic shrub, Cornus sericea, in the stands.

If the interpretation of the Montana Populus angustifolia/Poa pratensis community applies to the Sierra Madre

stands, then the Sierra Madre stands may be thought of as a grazing-induced community on the Populus angustifolia/Salix exigua habitat type. It's unclear, though, that grazing has removed a shrub layer from the Sierra Madre cottonwood stands to produce stands of the Populus angustifolia/Poa pratensis community. At least half of the Sierra Madre stands contain Artemisia cana or Chrysothamnus spp., which may indicate that they are on sites too dry to support more than scattered individuals of dogwood, rose, and willow. Even if these stands originally had well-developed strata of riparian shrubs, a decline in the water table or a rise in the soil surface (due to deposition of sediment) could have made the site unsuitable for the riparian shrubs. Cottonwood stands should be evaluated individually for evidence that grazing has indeed removed a formerly-widespread shrub layer, and cottonwood stands with different management histories should be investigated, before conclusions are drawn about the role of grazing in producing the Populus angustifolia/Poa pratensis vegetation. Moreover, a change in grazing management probably will not restore the shrub layers in existing cottonwood stands unless the stands still contain suppressed shrubs, because a Poa pratensis sod inhibits establishment of new shrubs (Hansen, Boggs, et al., 1991).

For discussions of resource values and management practices in this community, see USDA Soil Conservation Service (1988; specifically, see range site description for the lowland range site, 10-14" precipitation zone high plains southeast), and Hansen, Boggs, et al. (1991).

Other notes

Exotics are abundant in stands of the Populus angustifolia/Poa pratensis community (Table I-2). Three of these exotics -- Kentucky bluegrass, common dandelion, and Canada thistle -- have easily-transported seeds and are ubiquituous in North America, and their presence alone probably does not reflect any particular management practices. The large relative cover of Kentucky bluegrass, though, may be attributable to grazing (Hansen, Boggs, et al., 1991). Narrowleaf cottonwood stands so often have a high percentage of herbaceous exotics that the composition of the native understory is unclear. Soil Conservation Service information (USDA Soil Conservation Service, 1988) indicate that native understories in cottonwood stands (lowland range sites, 10-14" precipitation zone SE) contain primarily Elymus cinereus (basin wildrye), Agropyron smithii (western wheatgrass), Stipa comata (needle-and-thread grass), and other native grasses. This information may well apply to Populus deltoides stands (plains cottonwood) at lower elevation, however, rather than to Populus angustifolia stands.

The future of Populus angustifolia stands in the Medicine Bow National Forest requires dynamic streams to produce the disturbances that generate suitable sites for cottonwood

establishment. Management to regulate stream flows, through damming or diversion of streams, must recognize the importance of flood flows to cottonwood establishment.

TALL SHRUB PHYSIOGNOMIC CLASS

Salix geyeriana Series

This series contains stands with tall shrub layers in which Geyer willow or Pacific willow (*S. lasiandra*), alone or together, dominate or codominate.

Salix geyeriana/*Carex rostrata* Community

Occurrence

One of the stands with a shrub layer dominated by *Salix geyeriana* (Geyer willow) is considered an example of this community. The stand, represented by plot 333, was in Beaver Dam Park (Table 5), at an elevation of 8360 feet (Figure 3). Beaver Dam park is a wide, gently-sloping valley (Figures 4 and 5) with a straight stream (Figure 6). The plot was immediately along the stream channel (Figure 7), but on a surface nearly 2 meters above the channel (Figure 8). (The plot was next to a large abandoned beaver dam. The stream had breached the dam and incised the channel into the sediments behind the dam, accounting for the height of the surface with the plot above the channel.)

Vegetation

Salix geyeriana dominated the shrub layer, which contained some *Salix wolfii* (Wolf willow) (Table I-4). No other shrubs were present in the plot. *Carex rostrata* (beaked sedge) dominated the herbaceous understory, which contained substantial amounts of *Carex microptera* (small-winged sedge) and *Calamagrostis canadensis* (bluejoint reedgrass), and minor amounts of numerous forbs.

Relationship to other studies

A *Salix geyeriana*/*Carex rostrata* community has been described from western Wyoming (Youngblood et al., 1985), Montana (Hansen, Boggs, et al., 1991), northeastern Utah (Padgett et al., 1989), and north-central Colorado (Johnston, 1987, under the *S. geyeriana*-*Salix* spp./*Carex utriculata* plant association). Stands from these various areas have in common dominance of the shrub layer by Geyer willow and of the understory by beaked sedge. The Beaver Dam Park stand shares these features, and so is assigned to the community. Phillips (1977) describes a mesic willow shrub type from the upper Laramie River valley in the Medicine Bow Range just south of the Wyoming/Colorado state line that matches this community: the shrub layer in his type is dominated by

Salix geyeriana and contains substantial amounts of Salix monticola and S. drummondii (Drummond willow), and the understory contains large amounts of Carex rostrata, C. aquatilis (water sedge), and Calamagrostis canadensis (bluejoint reedgrass).

In western Wyoming (Youngblood et al., 1987) and Montana (Hansen, Boggs, et al., 1991) stands of this community typically occur on fluvial terraces in broad valleys, along the margins of ponds, and around springs. Many of the sites apparently are sediment-filled beaver ponds. Soils are fine-textured, have high water tables, and sometimes have an organic surface horizon. Along the Laramie River in north-central Colorado (Phillips 1977), this type occurs on mineral soils of loam and sandy loam textural classes, and on highly decomposed peats.

Succession/Management

Hansen, Boggs, et al. (1991) consider stands of this community in Montana stable enough (in terms of species composition and vegetation structure) in the absence of disturbance that they name it as the climax vegetation where it grows. Stands in western Wyoming also are stable for long periods in the absence of disturbance (Youngblood et al., 1985). Lowering of the water table, as occurs when beaver dams are breached and stream channels incise, probably results in shift of the understory to dominance by other species, especially Calamagrostis canadensis (Hansen, Boggs, et al., 1991). The vegetation then becomes a stand of the S. geyeriana/Calamagrostis canadensis community, described by Youngblood et al. (1985), Padgett et al. (1989), and Hansen, Boggs, et al. (1991) as occuring on drier sites than the S. geyeriana/Carex rostrata community. The location of the Beaver Dam Park stand adjacent to an incised channel, and the relatively large amount of Calamagrostis canadensis in the stand, suggest that it is undergoing this change. It's unclear from the data collected in this study and from the literature, though, if Salix geyeriana can maintain itself in a stand through establishment of seedlings (and the community truly is a climax type), or if stands of the willow must become established on bare areas like silt bars and sediment-filled beaver ponds (and the community is a long-lived seral type).

Youngblood et al. (1985) suggest that light surface disturbances decrease the relative amount of Carex rostrata in the understory and increase the relative amounts of Poa spp. (bluegrasses) and forbs, but that beaked sedge regains dominance after the disturbance ceases. Salix geyeriana may be more palatable to browsing animals than is S. boothii (Booth willow -- a common sub-dominant shrub in stands of this community) (Hansen, Boggs, et al., 1991), so browsing in stands with a mix of the two species in the shrub layer may change the overstory composition to dominance by Booth willow. Some stands of this community are wet enough to discourage livestock grazing, but

heavy grazing in the drier stands can shift the understory species composition to dominance by Poa pratensis (Hansen, Boggs, et al., 1991). The rhizomatous Carex rostrata (and other sedges often found in stands of the community) are especially good at binding soil (Hansen, Boggs, et al., 1991), so conversion of the understory to dominance by Poa pratensis may increase the potential for soil erosion.

Shrubs are more sensitive to long periods of grazing and to grazing in late summer than are sedges, so grazing systems that permit either type of grazing can reduce willow cover and may convert stands of this community to herbaceous types (Hansen, Boggs, et al., 1991). Hansen, Boggs, et al. (1991) discuss grazing practices that will protect the willows. Beaver may also remove willows from a stand and convert it to a Carex rostrata stand (Hansen, Boggs, et al., 1991), but Salix geyeriana sprouts following removal of stems (Hansen et al., 1988), and prolonged use by beaver probably is required to remove the species from a site. The ability of Geyer willow to sprout means that fire can be used to rejuvenate decadent stands (Hansen et al., 1988; Hansen, Boggs, et al., 1991).

Other notes

All of the references reviewed indicate that the Salix geyeriana/Carex rostrata community is a major riparian type along mountain streams. Those references contain information on the values of the community for livestock use, wildlife habitat, fish habitat, and watershed quality.

Salix geyeriana/Poa pratensis Community

Occurrence

Data were collected in six plots from four stands representing this community (Table 5). Four plots were in a stand extending for over a mile on branches of Big Creek in Cunningham and Holroyd Parks. The other two plots were also in stands on forks of Big Creek, but these stands were separate from the large stand in Cunningham and Holroyd Parks.

Five of the plots were at elevations around 8000 feet, and the sixth was at about 7000 feet elevation (Figure 3). Stands were in valleys from less than 400 feet wide to over 1/4 mile wide (Figure 4) with gentle slopes (Figure 5). Streams near the stands were fairly straight (Figure 6). The plots all were within about 10 meters of the stream channel (Figure 7), and up to 1 meter above the channel (Figure 8).

Vegetation

Salix geyeriana dominated or codominated the shrub layer in five of the stands, and was subordinate to Salix lasiandra in the sixth stand (Table I-4). S. lasiandra dominated in one plot,

codominated in a second plot, and was present in a third. Salix boothii was present in three of the seven plots. Numerous medium-height shrubs were present in most plots, and contributed substantial cover in some. Plot 741, in a stand on the South Fork of Big Creek, had substantial Pinus contorta cover but contained only three trees (Figure II-12). The stream near this plot ran close to the edge of the valley, and the plot was near the upland lodegepole pine forest.

Understories in the stands contained a rich array of graminoids and forbs (Table I-4). In all plots, Carex rostrata was absent or contributed relatively little cover. Exotic species were major contributors to understories in the stands: Poa pratensis was present in substantial amounts in three of the plots, Taraxacum officinale contributed substantial cover in three plots, and Trifolium pratense codominated one of the plots. Glyceria striata, a native grass of wet sites, codominated the understory in plot 631, but that plot also contained substantial amounts of Poa pratensis, Phleum pratense, and Trifolium pratense. (That plot was closer vertically to the channel than the other plots; Figure 8.)

Relationship to other studies

A Salix geyeriana/Poa pratensis community has been described by researchers in western Wyoming (Youngblood et al., 1985) and in Montana (Hansen, Boggs, et al., 1991). Stands sampled in those projects had shrub layers in which Geyer willow contributed substantial cover, and understories largely dominated by introduced graminoids and with little Carex rostrata. The Montana stands occur on the S. geyeriana/Calamagrostis canadensis habitat type or the S. geyeriana/Deschampsia caespitosa habitat type (Hansen, Boggs, et al., 1991). Soils in these sites, and the sites studied by Youngblood et al. (1985) in eastern Idaho, often are fine-textured, although some sites have sandy soils. Volume of gravel and cobbles may be high. Soils show evidence of a water table near the surface for at least part of the year. Phillips (1977) described a dry willow shrub type from the upper Laramie River in the Medicine Bow Range of north-central Colorado, with a shrub layer and an understory matching this community. (He points out that this this type occurs on dry sites relative to other willow types, but is still a community of wet riparian areas.) Soils in Phillips's stands were sandy loam or sand mineral soils.

Wasser and Hess (1982) describe a Salix geyeriana/Calamagrostis canadensis habitat type along low-gradient streams in mountain valleys of northern and central Colorado. Their description of this habitat type and associated vegetation resembles closely the habitat type of the same name described from Montana.

Padgett et al. (1989) named a Salix geyeriana/Mesic Graminoid community from Utah that is similar in composition to the S. geyeriana/Poa pratensis community named by the other authors. Stands from their study area generally grew on fine-textured soils, with only a few stands on soils with > 35% coarse fragments.

Six of the Geyer willow stands from the Sierra Madre are considered representatives of this community because the plot data suggest that their understories have little or no Carex rostrata and substantial amounts of introduced graminoids.

Succession/Management

This community is considered a grazing-induced variation of other types of Salix geyeriana shrublands (Youngblood et al., 1985; Padgett et al., 1989; Hansen, Boggs, et al., 1991). In western Wyoming and eastern Idaho (Youngblood et al., 1985), and in Montana (Hansen, Boggs, et al., 1991), stands occupy sites that apparently used to supported Salix geyeriana/Calamagrostis canadensis (bluejoint reedgrass). This community may also be a grazing-induced variant of Johnston's (1987) S. geyeriana-Salix spp./Calamagrostis canadensis plant association. Some Montana stands may occur on sites that used to support stands of the S. geyeriana/Deschampsia caespitosa community (Hansen, Boggs, et al., 1991). In Utah (Padgett et al., 1989), stands occur on sites that apparently formerly supported S. geyeriana/ Calamagrostis canadensis stands or S. geyeriana/Deschampsia caespitosa (tufted hairgrass) stands. These sites are drier than sites with S. geyeriana/Carex rostrata stands.

The discussion of succession and management of the Salix geyeriana/Carex rostrata community largely applies to this community, too. Browsing by wildlife may increase the amount of Salix boothii in the overstory (Hansen, Boggs, et al., 1991). Livestock grazing must be managed carefully to prevent loss of willows and to avoid shifting understory composition away from dominance by the palatable native grasses to dominance by exotic grasses and forbs, and thereby increasing the risk of soil erosion and loss of productivity (Youngblood et al., 1985; Padgett et al., 1989; Hansen, Boggs, et al., 1991). Beaver may remove willows from the stands, and decadent willow overstories may be rejuvenated with fire (Hansen, Boggs, et al., 1991). Sites supporting stands of this community are drier than sites with the Salix geyeriana/Carex rostrata community, though, and therefore probably receive more use from livestock. Moreover, understory composition in S. geyeriana/Poa pratensis stands apparently is stable once the exotic species gain dominance, and the native species are less likely to regain dominance when the disturbance is removed (Youngblood et al., 1985; Hansen, Boggs, et al., 1991).

Other notes

Publications from the studies in Idaho, Montana, and Utah discuss the value of this community in providing livestock forage, wildlife habitat, and watershed protection.

The literature suggests that stands of this community are less likely to occur on old beaver ponds than are the wetter Salix geyeriana/Carex rostrata stands. Conditions necessary for establishment of Geyer willows in these drier sites are unknown. These stands may have established on beaver ponds so long ago that the origin of the sites is obscure.

Other Salix geyeriana stand

Occurrence

One Salix geyeriana shrub stand, sampled with plot 231, does not fit in either the Salix geyeriana/Carex rostrata community or the S. geyeriana/Poa pratensis community. This stand is on North Soldier Creek (Table 5), at 8160 feet elevation (Figure 3). The valley is narrow and steep at that point (Figures I-2 and I-3), and the stream straight (Figure 6). The plot was next to the channel (Figure 7), and about a meter above it (Figure 8). The plot had considerable exposed rock and gravel at the surface (Table I-4), suggesting that the stand occurs on a cobble bar.

Vegetation

Salix geyeriana dominates the tall shrub layer in the stand, and Alnus incana is subdominant (Table I-4). Several medium-height shrub species are present, but only Juniperus communis contributes much cover. The stand contains numerous aspen seedlings (Figure II-13).

Aster adscendens and Solidago canadensis are the two main species in an understory rich in graminoids and forbs (Table I-4). Carex rostrata, Poa pratensis, and the exotic Trifolium spp. are absent or minor species.

Relationship to other studies

The lack of diagnostic understory species for the Salix geyeriana communities described in the literature -- Carex rostrata, Poa pratensis, and other mesic graminoids -- prevents assignment of this stand to any of those communities.

Other notes

The plot was in a narrow stand immediately next to the stream channel. The presence of gravel and cobbles on the surface suggests a different type of site than stands of the two Geyer willow communties grow on. Further investigation in the Sierra Madre and the Medicine Bow Mountains may show that this stand represents a Geyer willow type growing along streams in steep, narrow valleys.

Salix boothii Series

This series contains stands with tall shrub layers in which Booth willow dominates or codominates, and in which Geyer willow and Pacific willow are minor species (or from which they are absent).

Salix boothii/Poa pratensis Community

Occurrence

Data were collected in three *Salix boothii* (Booth willow) stands that seem to fall into this community. Two stands were on Battle Creek and one was on Big Sandstone Creek (Table 6). All three of the stands were just above 7000 feet elevation (Figure 3), in valleys from about 500 feet wide to 1000 feet wide (Figure 4) with gentle slopes (Figure 5). The stands on Battle Creek were along fairly straight stretches of stream, but Big Sandstone Creek in the vicinity of the Booth willow stand was sinuous (Figure 6). The *Salix boothii* plots were farther from the stream channel than plots of most other vegetation types (Figure 7), and were relatively high above the channel (Figure 8).

Vegetation

Salix boothii formed a tall shrub layer in each stand (Table I-5). *Lonicera involucrata* and *Ribes inerme* each contributed substantial medium-height shrub cover in one stand. The plot data indicate that composition of the herbaceous understory varied substantially between stands. *Poa pratensis* dominated or codominated in two stands, and was present in the third. The understory in this third stand (represented by plot 181) was codominated by *Glyceria striata* (a native grass of wet sites) and *Cirsium arvense* (Canada thistle), and contained a substantial amount of *Taraxacum officinale* (common dandelion). Numerous other species were present in smaller amounts.

Relationship to other studies

A *Salix boothii/Poa pratensis* community has been described from western Wyoming and eastern Idaho by Youngblood et al. (1985), and from Utah by Padgett et al. (1989). Both of these communities are characterized by a tall shrub stratum in which Booth willow contributes substantial cover (although *S. drummondiana* may dominate, and *S. geyeriana* may be present in substantial amount), and an understory with large amounts of species indicating disturbance or dry surface soils (or both), such as *Poa pratensis*, *Phleum pratense*, *Cirsium arvense*, *Bromus anomalus*, and *Bromus ciliatus*.

The Salix geyeriana/Poa pratensis community described from Montana (Hansen, Boggs, et al., 1991) includes stands with shrub strata dominated by Salix boothii and understories dominated by exotic species such as Poa pratensis, P. palustris, and Cirsium arvense. Some stands of this Montana community consequently fall into the S. boothii/Poa pratensis community of other authors.

Stands of this community in western Wyoming (Youngblood et al., 1985) and Utah (Padgett et al., 1989) occur on a range of soil types. Water tables generally are farther below the surface in stands of this community than in Salix geyeriana stands.

The Sierra Madre Salix boothii stands had understories dominated or codominated by Poa pratensis, Cirsium arvense, or both, and therefore considered occurrences of the Salix boothii/Poa pratensis community.

Succession/Management

Hansen, Boggs, et al. (1991) indicate that stands of this community are derived from S. boothii/Calamagrostis canadensis stands or S. boothii/Deschampsia caespitosa stands by grazing, often with a coincident drop in the water table. (These authors include both of these Booth willow communities in their S. geyeriana/Poa pratensis community.) According to these authors, the understory will continue to be dominated by species like Poa pratensis until the water table rises again. Padgett et al. (1989) agree that Booth willow/Kentucky bluegrass stands are derived from other Booth willow stands with high amounts of palatable forbs (their S. boothii/Mesic Forb community) by grazing. Youngblood et al. (1985) suggest that grazing of other Booth willow stands shifts the understory composition to dominance by exotic species, but they are uncertain what the original vegetation in these stands was. Replacement of native understory dominants by Poa pratensis is undesirable because Kentucky bluegrass is less effective in stablizing soil than are the native species (Padgett et al., 1989). Stands of this community may also be derived from Johnston's (1987) S. boothii-Salix spp./Calamagrostis canadensis plant association.

Heavy browsing of the willows, or consistent browsing during late summer and fall, can reduce the vigor of the shrubs and eventually cause them to disappear from the stand, as is true in Salix geyeriana stands. Healthy willows are critical to protecting soil from erosion, because willows are especially effective in binding soil (Hansen, Boggs, et al., 1991).

Other notes

Information on the requirements for establishment of Booth willow are unavailable from the data collected in the present study and from the literature references on the community. Consequently, the origin of Booth willow stands is unclear. The four stands sampled in the Sierra Madre are farther from the

stream channel, and higher above the stream channel, than are Salix geyeriana stands. Perhaps establishment of Booth willow stands depends less on creation of unvegetated sites by filling of beaver ponds or deposition of alluvial bars.

Youngblood et al. (1985), Padgett et al. (1989), and Hansen, Boggs, et al. (1991) discuss the values of Booth willow communities in providing forage and wildlife habitat and in protecting watersheds. For discussions of management practices in these stands, see the sections in Hansen, Boggs, et al. (1991) on the Salix geyeriana types.

Other Salix boothii stand

Occurrence

One Salix boothii stand sampled at Beaver Dam Park did not fit into the S. boothii/Poa pratensis community (Table 6). This stand was at a higher elevation than the other Booth willow stands (Figure 3), but in a valley of similar width (Figure 4) and slope (Figure 5) as the other stands. Sinuousity of the stream (Figure 6), distance to the channel (Figure 7), and height above the channel (Figure 8) were similar between this stand and the other Booth willow stands.

Vegetation

Salix boothii formed a dense tall shrub layer (Table I-5). The plot data indicate that the stand contained fewer shrubs and herbaceous species than did the other Booth willow stands. Carex microptera, Galium trifidum, and Geum macrophyllum were the only species contributing substantial cover to the understory in the plot.

Relationship to other studies

The species composition of this stand does not readily place it into any of the Booth willow communities described in the literature. More investigation of Booth willow stands in the Sierra Madre and Medicine Bow Range may show how it relates to other communities.

Alnus incana Series

This series includes stands with tall shrub canopies in which thinleaf alder dominates or codominates. Only one community was identified.

Alnus incana/Mesic Graminoid Community

Occurrence

Two stands of the Alnus incana/Mesic Graminoid community were sampled on Battle Creek, one stand was sampled on Big Sandstone Creek, and one stand was sampled on Big Creek (Table 7). Three stands were below 7500 feet elevation, and the fourth, on Big Creek, was at almost 8000 feet elevation (Figure 3). Valley width varied from less than 200 feet to 1000 feet (Figure 4), but all stands were on gently-sloping valley floors (Figure 5). Streams were moderately sinuous in the vicinities of the stands (Figure 6). All of the sampling plots were next to the stream channel (Figure 7), and half a meter or less above the channel (Figure 8).

Vegetation

The plot data indicate that Alnus incana dominated the tall shrub stratum in each stand (Table I-6). Salix boothii contributed substantial cover in one stand, and S. exigua in another stand. Several willows were present in small amounts in another stand. The Big Creek stand had substantial cover of Chrysothamnus parryi, and one stand on Battle Creek contained extensive cover of Populus angustifolia seedlings. In the other stand, medium-height shrubs and low shrubs otherwise were minor components of the vegetation.

Understories were a mix of graminoids and forbs (Table I-6). Calamagrostis canadensis dominated in the stand on Big Creek (plot 821), and Carex microptera was an important species. Numerous other native species (and two exotics) were present in small amounts. Understories in the other stands were mixtures of Glyceria striata, Poa pratensis, Eleocharis palustris, Juncus balticus, Erigeron glabellus, Maianthemum stellatum, Mentha arvensis, and Prunella vulgaris. Rudbeckia laciniata and Taraxacum officinale were present in these latter three stands, generally in small amounts.

Relationship to other studies

The Alnus incana/Mesic Graminoid community was described by Padgett et al. (1989) from Utah as a vegetation type with a low tree layer dominated by alder and a variable understory containing Poa pratensis, Glyceria striata, and a variety of other graminoids. Stands of this type occur on soils with a high volume of coarse fragments and a water table within a meter of the surface. The four Sierra Madre stands seem to fit well with Padgett's et al. (1989) description of this community.

Youngblood et al. (1985) described an Alnus incana/Ribes hudsonium community from western Wyoming, but the stands of that type generally contain a well-developed stratum of medium-height shrubs and an understory rich in forbs and relatively poor in graminoids. Hansen, Boggs, et al. (1991) name an Alnus incana

community from Montana, which seems to include a wider variety of stands than the community of Padgett et al. (1989). Alexander et al. (1986) listed an Alnus tenuifolia series (A. tenuifolia = A. incana var. tenuifolia) from the west side of the Sierra Madre and from the Laramie Peak area on the Medicine Bow National Forest, but they gave no information on vegetation or soils. Johnston (1987) also lists an A. incana ssp. tenuifolia series.

The alder series of the Medicine Bow National Forest extends into northern Colorado, where it apparently occurs on the Alnus tenuifolia/Equisetum arvense habitat type (Wasser and Hess, 1982). This habitat type lies on gently-sloping stream banks that are normally innundated in the spring and maintain a high water table throughout the summer. Soils contain a high volume of gravels and cobbles. This habitat type matches the description of the Utah sites supporting Alnus incana/Mesic Graminoid community stands (Padgett et al., 1989), and seems to describe the sites where stands were found in the Sierra Madre as well.

Succession/Management

Hansen, Boggs, et al. (1991) consider Alnus incana to be a long-lived seral species that establishes after disturbance (severe flooding) along high-energy streams. Stands originate on newly-deposited cobble bars, and trap finer sediments from later floods, thereby forming finer-textured soil horizons (Hansen et al., 1988). Alnus incana sprouts readily (Hansen et al., 1988), so after shrubs are established, they should be able to withstand subsequent flooding and the stand thereby be maintained. Migration of the stream channel away from the stand will prevent further seedling establishment, and the alders will eventually die out (Hansen et al., 1988). Alder stands may replaced by willow stands or conifer stands if sites remain undisturbed for sufficient time (Hansen, Boggs, et al., 1991).

Padgett et al. (1989) suggest that stands of the Alnus incana/Mesic Graminoid community are induced by grazing of forb-rich stands of the Alnus incana/Mesic Forb community.

Dense alder stands provide little forage for grazing animals, and alder is used to only a limited degree by browsing animals (Hansen, Boggs, et al., 1991). Alders stablize stream banks and enhance fish habitat (Padgett et al., 1989; Hansen, Boggs, et al., 1991). They respond well to cutting to maintain high productivity.

Other notes

Hansen, Boggs, et al. (1991) provide a good discussion of the values and management of alder stands. See, also, Hansen et al. (1988) and Padgett et al. (1989).

Alnus incana forms a ribbon of shrub vegetation along streams throughout the Sierra Madre and the Medicine Bow Range. Large stands, though, appear to be rare. The Alnus incana/Mesic Graminoid community may include stands on different sites with different management requirements, and further investigation may show that the community should be split.

Other Alnus incana stand

Occurrence

One Alnus incana stand sampled in the Medicine Bow Range along the Medicine Bow River upstream from Stillwater Park (Table 7) does not seem to fit into the A. incana/Mesic Graminoid community. This stand was at 9300 feet elevation (Figure 3), in a narrow, relatively steep part of the valley (Figures 4 and 5). The river at that point is relatively straight (Figure 6). The stand is immediately along the channel (Figure 7) and at the same level as the channel (Figure 8).

Vegetation

The tall shrub layer is dominated by Alnus incana and contains some Salix geyeriana (Table I-6). The sparse understory contains a number of graminoids and forbs, but few of them are present in more than trace amounts.

Relationship to other studies

The diagnostic species for various Alnus incana communities described in the literature, and present in the Alnus incana/Mesic Graminoid stands from the Sierra Madre, are absent from the this stand. The vegetation does not resemble any of the communities.

Other notes

This stand is a typical ribbon of alder between the stream channel and the Picea engelmannii forest.

MEDIUM SHRUB PHYSIOGNOMIC CLASS

Salix wolfii Series

This series includes stands with medium-height shrub canopies in which Wolf willow dominates or codominates.

Salix wolfii/Deschampsia caespitosa Community

Occurrence

One large stand of this community in Rock Creek Park of the Medicine Bow Range was sampled with two plots (Table 8). This stand was the highest stand sampled in the study (Figure 3). Rock Creek Park is wide (Figure 4) with a relatively gentle slope (Figure 5) in the region of the stand, and Rock Creek is relatively straight (Figure 6). The plots were within 10 meters of the stream (Figure 7) and about half a meter above it (Figure 8).

Vegetation

Salix wolfii forms a dense shrub layer in the stand, and Salix planifolia and Potentilla fruticosa are present (Table I-7). Carex microptera is the major understory species, and Deschampsia caespitosa and Phleum alpinum are present in significant amounts. Forbs contributing substantial cover include Achillea millefolium, Fragaria virginiana, and Taraxacum officinale.

Relationship to other studies

The Salix wolfii/Deschampsia caespitosa community has been described from western Wyoming (Youngblood et al., 1985), Montana (Hansen, Boggs, et al., 1991), and Utah (Padgett et al., 1989). Characteristic features are a medium-height shrub canopy dominated by S. wolfii and an understory with at least 5% cover of Deschampsia caespitosa. (Composition of the understory is variable.) The plot data from the Rock Creek Park stand indicate that the stand belongs to this community. Johnston (1987) reports a plant association of this name from Rocky Mountain National Park in north-central Colorado.

Soils associated with this community vary somewhat (Youngblood et al., 1985; Padgett et al., 1989; Hansen, Boggs, et al., 1991), but they typically have a fine-loamy to sandy loam surface horizon overlying gravel or cobbles, and are mottled near the surface, indicating a high water table at least part of the year. Padgett et al. (1989) concluded that surface soil horizons dry out more in stands of this community than in other Salix wolfii stands.

Phillips (1977) described a wet willow type in which Salix wolfii is an important overstory species along the upper Laramie River in north-central Colorado, but his type occurs on organic soils, and contains different understory species than stands of this community.

Succession/Management

Hansen, Boggs, et al. (1991) consider this vegetation type to be the climax vegetation on the Salix wolfii/Deschampsia

caespitosa habitat type. They note that with sufficiently heavy grazing, Deschampsia caespitosa will decrease in abundance and Poa pratensis, Fragaria virginiana, and Taraxacum officinale will increase in abundance. Heavy grazing also will weaken the willows, and may eventually cause them to disappear from the stand. Padgett et al. (1989) describe much the same response by the vegetation to grazing, and add that exotic clovers (Trifolium spp.) typically increase with grazing. They also note that the relatively dry surface soils allow easy access by grazing animals.

Other notes

Hansen, Boggs, et al. (1991) discuss the values this community provides for livestock, wildlife, and watershed protection.

Artemisia cana var. viscidula series

This series includes stands with medium-height shrub canopies in which mountain silver sagebrush dominates or codominates. One community was identified.

Artemisia cana viscidula/Poa pratensis Community

Occurrence

Data were collected from four stands of the Artemisia cana/Poa pratensis community (Table 9). All four stands were at relatively low elevation (Figure 3). They occurred in wide valleys and narrow valleys (Figure 4) with gentle slopes (Figure 5). One stand was along a sinuous portion of Big Sandstone Creek, but the other stands were along relatively straight stream stretches (Figure 6). Distance between the stands and stream channels ranged from 1 meter to over 15 meters (Figure 7), and height above the channel ranged from less than 0.5 meter to two meters (Figure 8).

Vegetation

Three of the four stands have a medium-height shrub layer strongly dominated by Artemisia cana var. viscidula (mountain silver sagebrush) (Table I-8). Plot data indicate that the fourth stand has a shrub canopy codominated by A. cana and Symphoricarpos occidentalis (western snowberry). Understories contain a variety of graminoids and forbs, and Poa pratensis (Kentucky bluegrass) dominates or codominates in the stratum. Other important species in at least one stand are Phleum pratense (meadow timothy), Stipa lettermanii (Letterman needlegrass), Achillea millefolium (western yarrow), Erigeron speciosus (Oregon fleabane), Taraxacum officinale (common dandelion), and Trifolium pratense (red clover).

Relationship to other studies

Youngblood et al. (1985) describe the Artemisia cana/Poa pratensis community as a minor vegetation type from western Wyoming, and Padgett et al. (1989) describe it as a major vegetation type in Utah. According to Youngblood et al. (1985), Artemisia cana dominates the shrub layer in this community, other shrubs are rare, and the herbaceous understory is dominated by a combination of several forbs and graminoids, usually including Poa pratensis and Phleum pratense. In Utah (Padgett et al., 1989), the community has a shrub layer dominated by Artemisia cana, which is usually the only shrub present, and an understory with large amounts of Poa pratensis or Carex praegracilis (field clustered sedge) and variable amounts of other graminoids and forbs, including Stipa lettermanii and Taraxacum officinale. (Although the authors of these two studies do not specify the variety of silver sagebrush, the elevation ranges given for stands in western Wyoming and in Utah, and the lists of associated species and adjoining communities, indicate that they are discussing A. cana var. viscidula, mountain silver sagebrush, rather than A. cana var. cana, plains silver sagebrush.)

In both Utah and western Wyoming, stands of this community occur on alluvial terraces with soils containing thick surface horizons of fine- to fine-loamy texture, sometimes with considerable volume of coarse fragments. Soils often are mottled, indicating occasionally high water tables. Nevertheless, this community occurs on the driest of riparian sites.

An Artemisia cana vegetation type has been described from riparian areas of Montana (Hansen et al., 1988; Hansen, Boggs, et al., 1991), but it apparently is a lower-elevation community with plains silver sagebrush, not mountain silver sagebrush.

Succession/Management

Youngblood et al. (1985) and Padgett et al. (1989) describe this community as a grazing type derived from the Artemisia cana/Festuca idahoensis community in western Wyoming or the A. cana/Festuca ovina or A. cana/Deschampsia caespitosa communities in Utah. These authors note that the locations of silver sagebrush stands on broad, gentle alluvial terraces makes them accessible to livestock, and the stands commonly are heavily grazed. This heavy grazing decreases the amounts of the native grasses, and increases amounts of less-palatable native forbs and of exotics like common dandelion, Kentucky bluegrass, meadow timothy, and clovers. Youngblood et al. (1985) suggest that understories can be returned to dominance by native species, albeit slowly, by reduction in grazing pressure. Johnston (1987) also lists an A. cana/Festuca idahoensis plant association, and stands of the A. cana viscidula/Poa pratensis community apparently are derived from that association.

Artemisia cana sprouts after fire, so burning stands of this community will result in rapid re-establishment of the shrub canopy (Youngblood et al., 1985). Forage production can be increased by killing the shrubs with herbicides (Youngblood et al., 1985), but herbicides must be used with extreme caution in riparian areas. Management recommendations for the loamy overflow range site, 15-19" precipitation zone foothills and mountains southeast (USDA Soil Conservation Service, 1988) may apply to stands of this type.

Other notes

This community is transitional between wet riparian areas and uplands. Nevertheless, the Artemisia cana/Poa pratensis community is considered a riparian vegetation type because stands of this community differ in species composition from upland vegetation types, and this difference in species composition results from greater availability of water on the stream valley sites where the silver sagebrush/Kentucky bluegrass stands occur.

Populus angustifolia seedling & sapling series

This series includes stands in which narrowleaf cottonwood seedlings or saplings dominate a medium-height shrub layer.

Populus angustifolia/Recent Alluvial Bar Community

Occurrence

Plot data were collected from two stands of Populus angustifolia (narrowleaf cottonwood) seedlings along Big Sandstone Creek and from one stand of narrowleaf cottonwood saplings along Battle Creek (Table 4), to characterize young cottonwood stands. These stands were on cobble and gravel bars immediately next to the stream channel (Figure 7) and less than half a meter above the channel (Figure 8).

Vegetation

Vegetation in the two stands of cottonwood seedlings consisted primarily of Populus angustifolia seedlings, the native grass Agrostis exarata, Equisetum laevigatum (horsetail), and the exotic clover Trifolium pratense (Table II-3). The sapling stand had a tall shrub layer of narrowleaf cottonwood saplings and traces of other shrubs, a small amount of cottonwood seedlings, and an understory dominated by exotic bluegrasses (Kentucky bluegrass, Poa pratensis; and fowl bluegrass, P. palustris), the native forb Senecio eremophilus, and the exotic forbs Taraxacum officinale (common dandelion) and Trifolium repens. Much of the ground surface in the seedling stands was bare gravel or rock. The sapling stand had smaller amounts of gravel and rock, and much larger amounts of bare soil and litter.

Relationship to other studies

The description of the Populus angustifolia/Recent Alluvial Bar community from Montana (Hansen, Boggs, et al., 1991) applies to the two cottonwood seedling stands and the cottonwood sapling stand sampled in the present study.

Succession/Management

Populus angustifolia becomes established on bare substrates after flood, but not on well-vegetated substrates or under tree canopies (Hansen et al., 1988; Hansen, Boggs, et al., 1991). The two seedling stands illustrate this habitat. In the absence of a scouring flood, the vegetation and the site probably develop in the manner that Akashi (1988) described for Populus deltoides (plains cottonwood) along the Bighorn River in northern Wyoming: the seedlings grow into the sapling class and the gravel and cobbles of the alluvial bar are gradually covered by finer-textured sediments deposited in smaller floods. (Note the small amount of gravel and cobble on the surface in the sapling stand, and the large amount of bare soil -- i.e., of fine-textured sediments.) This deposition of fine material and downcutting by the stream increase the height of the site above the stream channel, thereby decreasing the probability that a catastrophic flood will remove the vegetation and increasing the probability that the sapling stand will become a stand of cottonwood trees.

Young narrowleaf cottonwoods can sprout following browsing by ungulates or cutting by beaver, but trees lose this sprouting ability as they age (Hansen, Boggs, et al., 1991). Consequently, stands of seedlings and saplings can recover from browsing or cutting, if they are not browsed or cut too often. Repeated disturbance by ungulates or beaver can kill the young cottonwoods and prevent regeneration of cottonwoods in an area (Hansen, Boggs, et al., 1991). Ungulates are little threat to older trees, but beaver can remove stands of older trees.

Other notes

Exotics are common in the Populus angustifolia/Recent Alluvial Bar stands. Unfortunately, many weeds are well-suited to establishment in the same unvegetated sites that narrowleaf cottonwood seedlings need.

HERBACEOUS PHYSIOGNOMIC CLASS

Carex rostrata Series

This series contains stands of herbaceous vegetation dominated by sedges in which beaked sedge contributes at least 25% of the cover.

Carex rostrata Community

Occurrence

Data were collected on this community from four plots in three stands (Table 10). Elevation of the stands ranged from 8000 feet to almost 9500 feet (Figure 3), and all were in relatively wide valleys (Figure 4). Two of the stands were in gently-sloping valleys, and the third was in a valley with a slope of over 5% (Figure 5). Sinuousity of the streams near the stands varied widely (Figure 6). Stands lay as far as 15 meters from the stream channel (Figure 7), and as much as 1.4 meters above the channel (Figure 8).

Vegetation

Composition of the vegetation varied from stand to stand, but Carex rostrata (beaked sedge) dominated or codominated in every stand (Table I-9). Deschampsia caespitosa (tufted hairgrass) was present in every stand, and contributed substantial cover in one (represented by plots 211 and 212). Other graminoids present in substantial amounts in at least one stand were Bromus anomalus (nodding brome), Carex microptera (small-winged sedge), Hordeum brachyantherum (meadow barley), and Phleum pratense (meadow timothy). Forbs contributing substantial cover in at least one stand were Achillea millefolium (western yarrow), Frasera speciosa (showy elkweed), Geum macrophyllum (largeleaf avens), and Taraxacum officinale (common dandelion).

Relationship to other studies

The Carex rostrata community has been described from western Wyoming by Youngblood et al. (1985), from Utah by Padgett et al. (1989), and from Montana by Hansen, Boggs, et al. (1991). Youngblood et al. (1985) and Padgett et al. (1989) describe the vegetation as being strongly dominated by Carex rostrata, with few other species present. Hansen, Boggs, et al. (1991) apparently draw wider boundaries around the community, and allow more diversity in the vegetation. The plot data indicate that the stands sampled in the present study contain substantial amounts of various grasses, and therefore belong to the Deschampsia caespitosa phase of Hansen, Boggs, et al. (1991). Johnston (1987) considers this community to be part of his Carex aquatilis/Carex utriculata (=C. rostrata) plant association.

Stands described from the other studies (Youngblood et al., 1985; Padgett et al., 1989; Hansen, Boggs, et al., 1991) occur on sites with water tables at or above the soil surface during much of the growing season. Many of the sites with this community are old beaver ponds that have filled with sediment and organic matter. Organic soils (Histosols) are common on these sites, and mineral soils typically have fine loamy to sandy loam texture.

According to Hansen, Boggs, et al. (1991), the presence of this community denotes the Carex rostrata habitat type, and different phases of the community occur along a moisture gradient. The Deschampsia caespitosa phase, to which the Sierra Madre stands belong, occurs in the driest part of the habitat type. (Even these relatively dry sites are wetter than most riparian sites.) Wasser and Hess (1982) describe a Carex rostrata/Carex aquatilis habitat type from the Arapaho, Roosevelt, and White River National Forests of central and northern Colorado that apparently corresponds to the wettest and intermediate parts of the Carex rostrata habitat type of Hansen, Boggs, et al. (1991).

Succession/Management

Carex rostrata colonizes open mineral substrates with high water tables, such as sediment-filled or drained beaver ponds (Padgett et al., 1989; Hansen, Boggs, et al., 1991). Beaked sedge also colonizes organic substrates (Padgett et al., 1989). The thick sedge sod and persistently-high water tables exclude most other plants (Youngblood et al., 1985; Hansen, Boggs, et al., 1991), so the wet Carex rostrata vegetation constitutes a stable community (Youngblood et al., 1985). The dense network of sedge rhizomes also protects stands of the Carex rostrata community from all but the most abrasive floods (Youngblood et al., 1985). As the site becomes drier, either through decline in the water table or raising of the soil surface through deposition of sediment or organic matter, grasses and forbs appear in the stand (Youngblood et al., 1985). If the site continues to dry out, willows may begin growing in the stand (Salix wolfii at medium and high elevations; S. boothii or S. drummondiana at lower elevations, followed by S. geyeriana if the site dries sufficiently), and the stand becomes Salix sp./Carex rostrata vegetation.

Phillips (1977) proposes a successional sequence for the upper Laramie River valley in which a beaked sedge - water sedge fen is the first vegetation type to form in the backwaters of beaver ponds. The sedge fen eventually becomes a willow stand, as accumulation of organic matter raises the land surface and allows establishment of willows.

The wetness of Carex rostrata stands and the relatively low palatability of beaked sedge discourage grazing animals (Youngblood et al., 1985; Hansen, Boggs, et al., 1991), although narrow stands may be grazed heavily. Heavy use by livestock, hikers, and off-road vehicles can create trails through stands, exposing the underlying soil (Hansen, Boggs, et al., 1991). Beaked sedge (and other rhizomatous sedges) provide especially good protection for streambanks and floodplains, and therefore are beneficial for fish habitat and watershed quality (Youngblood et al., 1985; Hansen, Boggs, et al., 1991). Grazing must be controlled to assure that enough standing biomass remains to trap

sediment during subsequent floods and maintain high water quality (Hansen, Boggs, et al., 1991).

Other notes

See Hansen, Boggs, et al. (1991) for further discussion of management practices suitable for this community.

Carex aquatilis Series

This series contains stands of herbaceous vegetation dominated by sedges in which water sedge contributes at least 25% cover.

Carex aquatilis Community

Occurrence

Date were collected from one stand of the Carex aquatilis (water sedge) community along Battle Creek (Table 11). This was a low-elevation site (Figure 3) in a wide segment of the valley (Figure 4) with gentle slope (Figure 5) along a relatively straight stream stretch (Figure 6). The stand was immediately next to the stream channel (Figure 7) and at the same level as the channel (Figure 8).

Vegetation

Carex aquatilis dominated the vegetation, and C. pensylvanica (penn sedge) and Juncus balticus (baltic rush) were present in substantial amounts (Table I-10). Tall Mertensia spp. (bluebells) was the only major forb in the plot. Few other species were present.

Relationship to other studies

Youngblood et al. (1985) and Padgett et al. (1989) describe a Carex aquatilis community from western Wyoming and from Utah, respectively. In their community, C. aquatilis dominates the vegetation, and other species (including Juncus balticus) are present in varying amounts. Hansen, Boggs, et al. (1991) describe a C. aquatilis community from Montana, and divide it into two phases. The Battle Creek stand falls into their Deschampsia caespitosa phase, due to the presence of a substantial amount of Juncus balticus. Johnston (1987) reports the community from Rocky Mountain National Park in north-central Colorado under the Carex aquatilis/Carex utriculata (=C. rostrata) community, C. aquatilis phase.

Stands of this community occur on nearly-level sites in valley bottoms, often on sediment-filled beaver ponds and old channels or as narrow zones along active channels (Youngblood et al., 1985; Hansen, Boggs, et al., 1991). These sites apparently are slightly drier than sites supporting Carex rostrata stands

(Youngblood et al., 1985; Hansen, Boggs, et al., 1991), but whether a site is dominated by Carex aquatilis or by C. rostrata may depend simply on which species was established first on the site (Padgett et al., 1989). Carex aquatilis withstands a decrease in the water table better than does C. rostrata (Padgett et al., 1989). Padgett et al. (1989) and Hansen, Boggs, et al. (1991) report that stands of this community usually occur on organic soils (Histosols), but Youngblood et al. (1985) mention them as commonly growing on poorly-developed mineral soils.

According to Hansen, Boggs, et al. (1991), presence of the Carex aquatilis community denotes the C. aquatilis habitat type. These sites may be included in the Carex rostrata/Carex aquatilis habitat type described by Wasser and Hess (1982) from the Arapaho, Roosevelt, and White River National Forests of central and northern Colorado.

Succession/Management

Hansen, Boggs, et al. (1991) describe the ecological role of Carex aquatilis as similar to that of C. rostrata, in that both are pioneer species on recently-exposed mineral soils with high water tables, and both species are able to exclude establishment of other plants. The two species differ, though, in that Carex aquatilis is palatable to cattle and horses (Hansen, Boggs, et al., 1991) and, consequently, heavy grazing is more likely to reduce the importance of water sedge in a stand and allow invasion by other species. Grazing also often exaggerates the hummocking of the soil surface in the stands.

Phillips (1977) proposes a beaked sedge - water sedge fen as the primary vegetation type on beaver ponds in the upper Laramie River valley. The sedge fen eventually becomes a willow stand as organic matter accumulates and raises the land surface.

Besides providing forage to livestock, Carex aquatilis stands provide excellent protection to streambanks and floodplains, and therefore promote good fish habitat and water quality (Hansen, Boggs, et al., 1991). Management must recognize these functions, and protect stands from overgrazing. Grazing should also be conducted to leave sufficient standing crop to trap sediments (Hansen, Boggs, et al., 1991).

Other notes

See Hansen, Boggs, et al. (1991) for further discussion of values and management of Carex aquatilis stands. Padgett et al. (1989) discuss sites dominated by C. aquatilis and sites dominated by C. rostrata.

Carex microptera Series

This series includes stands of herbaceous vegetation dominated by sedges in which small-winged sedge contributes at least 25% cover.

Carex microptera Community

Occurrence

One stand of the Carex microptera (smalle-winged sedge) community was sampled at Beaver Dam Park (Table 12), at about 8500 feet elevation (Figure 3) in a wide, gently-sloping valley (Figures 4 and 5). The stream is nearly straight there (Figure 6). The location of the plot indicates that the stand was over 100 meters from the stream (Figure 7) and nearly two meters above the channel (Figure 8).

Vegetation

Carex microptera and Deschampsia caespitosa (tufted hairgrass) formed a herbaceous layer that contained few other species (Table I-10). The estimates of total graminoid cover and total forb cover indicate that the stand was relatively open.

Relationship to other studies

Youngblood et al. (1985) and Padgett et al. (1989) describe a Carex microptera community from western Wyoming and eastern Idaho and from Utah, respectively, on gently-sloping alluvial terraces. Stands of this community generally merge into Carex rostrata stands on wetter sites and into Deschampsia caespitosa stands on drier sites (Youngblood et al., 1985), and they often are small patches in complexes of communities in the riparian zone (Padgett et al., 1989). The mineral soils beneath the stands usually are of fine-loamy or clayey particle size classes, and may contain a substantial volume of coarse fragments (Youngblood et al., 1985; Padgett et al., 1989). Presence of mottles indicates a seasonally-high water table, but the water table is lower for part of the year than on sites supporting C. rostrata (beaked sedge) and C. aquatilis (water sedge). (Note that the C. microptera stand at Beaver Dam Park is farther from the stream channel and higher above the stream channel than stands of C. rostrata or C. aquatilis.)

Hansen et al. (1988) describe a Carex microptera dominance type (equivalent to the series level used in the present classification) in Montana. Vegetation, sites, and soils are similar to those described from Wyoming, Idaho, and Utah. Presence of a significant amount of Deschampsia caespitosa, as in the Beaver Dam Park stand, indicates that the stand is near the dry end of the moisture gradient for this vegetation type.

Johnston (1987) lists a C. microptera/Deschampsia cespitosa plant association that he bases on the C. microptera community of Youngblood et al. (1985).

Succession/Management

Youngblood et al. (1985) suggest that dominance by Carex microptera indicates grazing disturbance. Padgett et al. (1989) caution that the caespitose (bunch growth form) C. microptera is more susceptible to grazing and trampling than associated sod-forming species, and heavy grazing may convert stands of this community to Poa pratensis (Kentucky bluegrass) stands. C. microptera is moderately palatable to cattle and horses, but stands often are so small that they yield relatively little forage (Youngblood et al., 1985).

Despite its caespitose habit, Hansen et al. (1988) describe Carex microptera as an effective binder of soil, and urge that stands be managed to prevent loss of the sedge. Padgett et al. (1989) point out that this community occurs on fine-textured mineral soils susceptible to compaction by heavy equipment and by livestock.

Other notes

This community seems to be relatively poorly known, and further investigations will yield better management guidelines (Youngblood et al., 1985).

Juncus balticus Series

This series includes stands of herbaceous vegetation in which sedges contribute less than 50% of the cover and Baltic rush contributes at least 25% of the cover.

Juncus balticus Community

Occurrence

One stand of this community was sampled (Table 13) in the wide, gently-sloping valley of Battle Creek (Figures 4 and 5) at an elevation of 7000 feet (Figure 3). Battle Creek is relatively straight at that point (Figure 6). The stand was within 5 meters of the stream channel (Figure 7) and less than 1.5 meters above the channel (Figure 8).

Vegetation

Plot data indicate that the stand contained few shrubs and a herbaceous layer rich in species (Table I-10). Juncus balticus (baltic rush) contributes the most cover, and Phleum pratense (meadow timothy) is a secondary species. Other important species

are Agrostis exarata (spike bentgrass), Carex spp. (unidentified sedges), and Taraxacum officinale (common dandelion).

Relationship to other studies

This community has been described from western Wyoming and eastern Idaho by Youngblood et al. (1985), from Montana by Hansen, Boggs, et al. (1991), and from Utah by Padgett et al. (1989) on alluvial terraces and in meadows. Juncus balticus dominates the vegetation, and numerous exotic and native graminoids and forbs may contribute substantial cover. Soils are well-developed and have thick surface horizons rich in organic matter (Cryaquolls and Cryoborolls). Particle-size classes typically are fine-loamy or finer, although Montana stands may occur on fine sandy loams (Hansen, Boggs, et al., 1991). The water table is near the surface in the spring, but commonly drops to a meter or more below the soil surface in the summer.

Johnston (1987) lists a Juncus arcticus/Carex spp. plant association for USFS Region 2 forests that includes this community.

Succession/Management

This is a grazing-induced community (Youngblood et al., 1985; Padgett et al., 1989; Hansen, Boggs, et al., 1991). In Utah, stands of the Juncus balticus community apparently replace Carex nebrascensis (Nebraska sedge) stands or Poa pratensis (Kentucky bluegrass) stands (Padgett et al., 1989). In Montana, stands of this community develop on the Deschampsia caespitosa (tufted hairgrass) habitat type or the Calamagrostis canadensis (bluejoint reedgrass) habitat type (Hansen, Boggs, et al., 1991). J. balticus withstands heavier grazing than do most other plants (USDA Forest Service, 1937), so the species increases in relative abundance with heavy grazing (Youngblood et al., 1985; Hansen, Boggs, et al., 1991). Grazing of J. balticus, though, apparently allows exotic species to become common in the stand (Youngblood et al., 1985; Hansen, Boggs, et al., 1991).

Juncus balticus spreads by tough rhizomes and is particularly effective in reducing soil erosion (Youngblood et al., 1985; Padgett et al., 1989; Hansen, Boggs, et al., 1991). The fine-textured soils on which stands often occur are subject to compaction when wet, which reduces productivity of the stand (Hansen, Boggs, et al., 1991). J. balticus is palatable to livestock when young, but becomes tough and unpalatable as it ages (USDA Forest Service, 1937). Palatability also depends on the density of the stand and the amount of other species present. Dense stands may be productive, but are little-used by livestock.

Other notes

See Hansen, Boggs, et al. (1991) for more information on management practices for this type. Stands of this community

apparently grow on the wetland range site, 10-14" precipitation zone high plains southeast, or the wetland range site, 15-19" precipitation zone foothills and mountains southeast (USDA Soil Conservation Service, 1988).

Unclassified Stands

Occurrence

Based on the plot data, six stands did not fit into existing classifications of riparian plant communities and were so heterogeneous that they could not be placed together into a new community (Table 14). These stands occurred over a range of elevations (Figure 3), valley widths (Figure 4), and valley slopes (Figure 5). Sinuousity of streams near the stands was also variable (Figure 6). All of the stands were near the stream channel (Figure 7), but they ranged from the level of the channel up to 2 meters above the channel (Figure 8).

Vegetation

Composition and structure of the vegetation differed widely between stands (Table I-11). Only one of the stands (plot 811) had a well-developed shrub layer. Exotic plants, especially Phleum pratense (meadow timothy), Poa pratensis (Kentucky bluegrass), and Taraxacum officinale (common dandelion) were common in the stands, and Cirsium arvense (Canada thistle) contributed substantial cover in one stand. Specimens representing major plants in plot 441 could not be identified to species.

Plot 111 from Battle Creek may have included an occurrence of the Eleocharis palustris (creeping spikerush) community described by Padgett et al. (1989), Hansen et al. (1988), and Hansen, Boggs, et al. (1991). E. palustris dominates stands of this community, and various other plants of saturated soils are common. The Battle Creek plot, though, contained large amounts of graminoids and forbs characteristic of drier soils, especially Phleum pratense, Poa pratensis, and Taraxacum officinale. The large plot was placed in a meadow with old stream channels running through it, and may have included parts of an E. palustris stand and a drier adjacent stand.

DISCUSSION

A plot represents a stand of a vegetation type, so the relationships of plots to elevation, valley width, valley gradient, stream sinuousity, distance from stream channel, and height above stream channel illustrate the relationships of each series or community to these physical environmental variables. The Populus angustifolia/Poa pratensis, Populus angustifolia/Recent Alluvial Bar, Artemisia cana, and Alnus

incana/Mesic Graminoid communities all appear to occur at relatively low elevations (Figure 3). The other stands in the Alnus incana series were found at mid- and high elevations, and the Salix wolfii community and the Picea engelmannii/Galium triflorum community apparently are high-elevation types. Other communities were sampled too infrequently to allow conclusions about their elevations, or they occurred over a range of elevation.

Valley floor width at a spot is a rather poor predictor of whether a community will occur at that spot. Populus angustifolia/Poa pratensis stands, Salix boothii/Poa pratensis stands, and Carex rostrata stands all occurred at points where the valley was wider than 400 feet (Figure 4), which may indicate that these communities will only be found in valleys wider than a threshold width, where the stream has enough room to meander and create bars and islands of different ages. Stands of other communities were spread across a wide range of valley widths. Valley gradient also seems to be a poor predictor of what vegetation type will occur at a point. Only the Populus angustifolia/Poa pratensis stands, Populus angustifolia/Recent Alluvial Bar stands, and Salix boothii/Poa pratensis stands were restricted to gently-sloping valleys (Figure 5), and stands of the cottonwood types were all on only two streams.

The vegetation types generally do not differ from one another in the sinuousity of the stream stretch along which they occur (Figure 6), although Populus angustifolia/Poa pratensis, Populus angustifolia/Recent Alluvial Bar, and Alnus incana stands were only sampled along stream stretches with sinuousities greater than 1.1, and the two Picea types were only sampled along stretches with sinouusities less than 1.1. The P. angustifolia/Recent Alluvial Bar stands are young enough that they can be reasonably expected to show a relationship to current (or recent) sinuousity of the stream stretch. Other stands no doubt are older, and each of those stands may have responded to sinuousity at the time it was established, but sinuousity of the stretch by the stand has since changed.

Elevation, valley width, valley gradient, and sinuousity express conditions over a considerable portion of the valley. The two remaining variables -- distance from the nearest stream channel and height above the nearest stream channel -- are properties of the environment in the immediate area of the stand. Distance from the stream channel can be an indicator of flood disturbance in the stand: size, frequency, and duration of floods are greatest near the channel and decrease with increasing distance from the channel (Gregory et al., 1991), so stands near the channel experience more flood disturbance than stands far from the channel. Height above the channel also should indicate, to some degree, the amount of flood disturbance, with higher stands experiencing less disturbance than low stands. Height

above the channel also reflects wetness of the site, because the water table in the riparian zone typically is at about the same height as water in the channel (Brian Richter, The Nature Conservancy, personnel communication), so stands high above the channel will also be high above the water table. Picea engelmannii/Galium triflorum stands and Populus angustifolia/Recent Alluvial Bar stands all occurred right next to the channel and no more than half a meter above the channel. The proximity of young cottonwood stands to the stream channel reflects their requirement for poorly-vegetated (i.e., recently-flooded) sites for establishment. The location of the Engelmann spruce stands so near the channel indicates that the species in the stands can tolerate the disturbance on the sites. Two of the Alnus incana stands also lay along the channel. Alder is known for its ability to resist damage from floods.

The extensive overlap between stands of different communities in distance from channel and height above channel suggests that these variables are poor predictors of what vegetation type will occur on a site, or where stands of a particular community will occur. This poor predictive power probably results in part from inaccurate estimates of height of the plot above the stream channel. Differences of less than a foot can have marked effects on riparian vegetation (Brian Richter, The Nature Conservancy, personnel communication), and estimates of height above the channel are unlikely to perceive such small differences. Careful measurement of height probably is required to show the effect of height on vegetation. Further study of these riparian communities may reveal differences in the sites they occupy in the riparian zone.

USE OF THE CLASSIFICATION

This classification of riparian vegetation types can serve at least four purposes for land managers and biologists.

1. Inventory. First, the classification identifies vegetation units that land managers can use in inventorying the amounts of various riparian vegetation types on the Medicine Bow National Forest. An attempt has been made to designate levels in the hierarchy of vegetation types that can be used for different types of inventory (Figure 2). For example, different physiognomic classes can be distinguished on aerial photos, so land managers can use aerial photos (or other forms of remote sensing data) to locate and inventory these broad vegetation types. A practiced photo interpreter probably can distinguish between canopies dominated by different overstory species, so remote-sensing data perhaps can be used to locate and inventory series. By "ground-truthing" aerial photos (that is, by comparing a patch on a photo with data collected from that patch on the ground), managers can sharpen their abilities to inventory

vegetation units at the lowest level of the classification. More sophisticated remote sensing data (such as aerial videography) may be particularly useful for detailed inventory. Inventory of series and communities may require on-the-ground work.

2. Organizing information. The classification allows resource managers to organize information about resource values and management practices. Ecologists who produce vegetation classifications try to identify vegetation units that are more than simply arbitrary combinations of species; they try to describe vegetation units (series and communities) that indicate different environments or different disturbance histories, that yield different values, and that require different management practices. For example, a wildlife biologist reading the description of the Booth willow/beaked sedge community may recognize that stands of this community provide good nesting habitat for a guild of flycatchers, or good winter browse for moose. Perhaps the biologist will know (or will learn) that all of the communities with Booth willow overstories -- that is, all the communities in the Booth willow series -- are equally valuable for certain groups of animals, and she or he will not need to consider the Booth willow communities separately; she or he can just think about the Booth willow series. Maybe all tall willow vegetation types are so similar in use by wildlife that the biologist can lump the Booth willow series and the Geyer willow series together in his or her management plans.

A range manager, on the other hand, might keep the communities in the Booth willow series separate in his or her management plans, because different communities in that series have the potential to provide different amounts of forage, and (because they occur on different types of soil) require different grazing management to protect the productivity of the site. Similarly, an engineer might recognize that some communities denote soils that compact severely and erode, and some communities denote soil types that resist damage from most uses. The classification can be viewed as a bookeeping tool, in that it should allow biologists and managers to organize information on riparian areas.

It was impossible to collect enough information from the stands sampled in this project to show what values each vegetation type yields and what management practices each requires. Fortunately, published classifications of riparian vegetation types and habitat types in western Wyoming (Youngblood et al., 1985), Montana (Hansen et al., 1985; Hansen, Boggs, et al., 1991), Utah (Padgett et al., 1989), and, to a limited extent, Colorado (Wasser and Hess, 1982) contain information on resource values and management practices for riparian vegetation types. The series and communities identified from the data collected in this study have been related to the series and communities described in those publications, so that biologists

and managers can go to the published literature for that information.

3. Prediction. Riparian zones are dynamic places. Streams flood, scouring sites next to the channel or depositing sediments on them; stream channels move across the valley, eroding existing sites and laying down new ones; beaver dams come and go, with resulting increases and decreases in the water table on nearby sites, and creation of new flat, open sites; and plants are established, grow, and die, changing the structure of the vegetation with time. An inventory of the current mix of riparian communities on a site will tell biologists and managers what values the site yields now, and what management practices are appropriate to get those values. But the mix of communities on that site will change, and managers need a way to predict what communities will be there in the future, and what mix of values the site can yield in the future.

Predicting future mixes of communities on a site requires that we know the successional relationships between communities. The plot data contain a little evidence on these relationships in the stands sampled in this report, and that evidence is discussed when appropriate. One field season's worth of data, though, yields little information on succession, but by relating the communities on the Medicine Bow National Forest to communities described in the literature, we can take advantage of the published information on successional relationships. Each section on a vegetation type also summarizes the information on succession from the western Wyoming, Montana, and Utah classifications.

4. Identify further information necessary for management. This report identifies the major riparian vegetation types in the Sierra Madre, and summarizes information on vegetation dynamics and management. It also highlights two types of information that need to be gathered for management of riparian areas on the Forest. The first type is information on composition and structure of vegetation types not covered in this classification. This project emphasized low-elevation streams in the Sierra Madre, and we must expect to new find vegetation types at higher elevations in the Sierra Madre, and on streams at all elevations in the Medicine Bow Range. The hierarchical arrangement of vegetation types in this classification allows managers and biologists on the Forest staff to add information about new vegetation types in an efficient manner. Data from additional stands can be compared to data for the stands in the existing series and communities, and the new stands placed in the series or community with the stands they most closely resemble. The new stands may represent entirely new series or, perhaps, new physiognomic classes. The framework provided by this classification (Figure 2) can be expanded or filled in as

managers and biologist become familiar with it and new data are gathered.

Furthermore, as biologists and managers work with this classification, they may find that it does not divide the riparian vegetation on the Forest into the best units for management. Some communities described here may include two or more vegetation types with different management requirements and should be subdivided.

The second type of information necessary to augment this classification is information on which vegetation types regularly occur together throughout the Forest. The series and communities described in the classification usually occur as small stands in the riparian zone. Along sinuous streams like Battle Creek and Big Sandstone Creek, the riparian zone may be several hundred yards wide, but soil texture, height of the land surface above the water table, disturbance history, and other environmental factors vary greatly throughout the riparian zone and the vegetation consists of a mosaic of small stands of different types. Along constrained streams, like the stretch of North Soldier Creek for about 2 miles above the Forest boundary, the riparian zone commonly is narrow, and includes ribbon-like stands of a few riparian series or communities. Even in wide valleys with straight streams, like Rock Creek Park, the riparian zone may include a large stand of one riparian community over much of the valley and small stands of another community immediately next to the channel.

The small sizes of stands of riparian communities, the complicated patterns in which stands of different types occur, and the dynamic nature of the riparian zone mean that managers can't write management plans for individual stands in riparian zones, as they can in upland vegetation types. They may not even be able to inventory stands of the series or communities. Rather, they must inventory and manage larger units. Winward and Padgett (1989) have suggested that a logical unit for inventory and management is the riparian complex -- a recurring combination of stands of different communities. Just as the community is a recurring combination of species indicating a particular environment with particular management needs, the riparian complex is a recurring combination of stands indicating a particular combination of environments that regularly occur together. For example, a meandering stream in a broad alluvial valley creates a pattern of point bars, abandoned channels, and terraces of different ages and heights. These landforms provide different environments, and they should support different communities.

The mix of communities in a complex determines what values that riparian complex can yield, and how different parts of the complex will respond to management. This classification of

series and communities describes the major building blocks of riparian complexes, and provides information on the dynamics and management of those building blocks. Identifying those complexes should be a straightforward matter of choosing stretches of streams around the Forest, using the key to vegetation types in this classification to identify the communities present in each stretch (Appendix V), and calculating which communities regularly co-occur.

By mapping complexes, biologists and managers may discover that certain complexes often occur together along similar streams and thereby identify different stream types. For example, streams in broad, gently-sloping, alluvial valleys below 7500 feet elevation may exhibit similar combinations of stretches with old beaver ponds, stretches of braided channels, and stretches of sinuous channel with actively-eroding banks and new point bars. Each of these stretches could be expected to support a different combination of communities (i.e, a different riparian complex), and the complexes in turn would occur in similar combinations on the different streams. (See Gregory et al., 1991, for a discussion of the hierarchical nature of landforms and processes in riparian zones.) The complexes or the combinations of complexes might be the most suitable units for management, but they are built of stands of different communities.

This work of identifying riparian complexes certainly will reveal additional communities not included in this classification. It also can yield better information on the relationship between communities and the physical environment.

Table 1. Locations and sizes of plots in stands of the Picea engelmannii/Galium triflorum community.

Plot 213. North Soldier Creek, at southwest edge of a park about 0.5 mile upstream from Forest Road 550; T13N, R84W, Sec 20, SW1/4 NE1/4). Plot size 10 m x 10 m.

Plot 221. North Soldier Creek, immediately below crossing of Forest Road 550; T13N, R84W, Sec 17, SE1/4 SE1/4). Plot size 10 m x 10 m.

Plot 311. Several hundred feet north of Beaver Dam Park, along tributary of the East Fork of the Encampment River; T12N, R84W, Sec 12, NW1/4 SW1/4). Plot size 10 m x 10 m

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Table 2. Locations and sizes of plots in stands of the Picea pungens series.

These two plots are from the same stand.

Plot 511. North Fork of Big Creek, near the northwestern end of Cunningham Park; T12N, R82W, Sec 1, NW1/4 NW1/4. Plot size 10 m x 10 m.

Plot 521. North Fork of Big Creek, at the northwestern end of Cunningham Park; T12N, R82W, Sec 2, NE1/4 NE1/4. Plot size 10 m x 10 m.

Table 3. Locations and sizes of plots in stands of the Populus angustifolia/Poa pratensis community.

Plot 121. Battle Creek, about 0.75 mile downstream from the crossing of Forest Road 807; T13N, R87W, Sec 21, NE1/4 SW1/4. Plot size 20 m x 20 m.

Plot 132. Battle Creek, about 1.5 miles downstream from the crossing of Forest Road 807; T13N, R87W, Sec 20, SW1/4 SE1/4. Plot size 10 m x 20 m.

Plot 141. Battle Creek, about 1 mile downstream from the crossing of Forest Road 807; T13N, R87W, Sec 20, SE1/4 SE1/4. Plot size 20 m x 20 m.

Plot 171. Battle Creek, about 2.5 miles downstream from the crossing of Forest Road 807 and about 3/4 mile upstream from the Forest boundary; T13N, R87W, Sec 30, SW1/4 NE1/4. Plot size 20 m x 20 m.

Plot 422. Big Sandstone Creek, about 4.5 miles downstream from the crossing of Forest Road 801 and about 3 miles upstream from the Forest boundary; T14N, R88W, Sec 28, NE1/4 NE1/4. Plot size 20 m x 20 m.

Plot 451. Big Sandstone Creek, about 2.5 miles downstream from the crossing of Forest Road 801; T14N, R88W, Sec 23, SW1/4 NE1/4. Plot size 20 m x 20 m.

Table 4. Locations and sizes of plots in stands of the Populus angustifolia/Recent Alluvial Bar Community.

Plot 151. Battle Creek, about 1.5 miles downstream from the crossing of Forest Road 807; T13N, R87W, Sec 20, SW1/4 SE1/4). Plot size 20 m x 20 m.

Plot 413. Big Sandstone Creek, about 3.5 miles downstream from the crossing of Forest Road 801; T14N, R88W, Sec 22, SE1/4 SE1/4). Plot size 10 m x 10 m.

Plot 431. Big Sandstone Creek, about 4.5 miles downstream from the crossing of Forest Road 801; T14N, R88W, Sec 27, NW1/4 NW1/4). Plot size 20 m x 20 m.

Table 5. Locations and sizes of plots in Salix geyeriana stands.

Salix geyeriana/Carex rostrata community

Plot 333. Beaver Dam Park; T12N, R84W, Sec 11, SE1/4 SE1/4. Plot size 10 m x 10 m.

Salix geyeriana/Poa pratensis community

Plot 631. Middle Fork of Big Creek, about the middle of the canyon between Big Creek Park and Cunningham Park; T12N, R82W, Sec 12, NW1/4 SE1/4. Plot size 10 m x 10 m.

Plot 741. South Fork of Big Creek, about 1/2 mile upstream from the mouth of Holroyd Creek; T12N, R81W, Sec 17, NE1/4 SW1/4. Plot size 10 m x 10 m.

(The following 4 plots are from one large stand.)

Plot 531. North Fork of Big Creek, about the middle of Cunningham Park; T12N, R82W, Sec 1, SE1/4 NW1/4. Plot size 10 m x 10 m.

Plot 731. South Fork of Big Creek, about 250 feet downstream from the mouth of Holroyd Creek and about 300 feet upstream from the crossing of Forest Road 498; T12N, R81W, Sec 17, NW1/4 NW1/4. Plot size 10 m x 10 m.

Plot 721. South Fork of Big Creek, in Holroyd Park about 0.5 mile upstream from the confluence with the Middle Fork of Big Creek; T12N, R81W, Sec 7, SW1/4 NE1/4. Plot size 10 m x 10 m.

Plot 611. Middle Fork of Big Creek, in Cunningham Park about 500 feet upstream from the confluence with the North Fork of Big Creek; T12N, R81W, Sec 7, NW1/4 NW1/4. Plot size 20 m x 20 m.

Other stand.

Plot 231. North Soldier Creek, about 2.5 miles downstream from the crossing of Forest Road 550 and about 1.25 miles upstream from the Forest boundary; T13N, R84W, Sec 10, NW1/4 NE1/4. Plot size 10 m x 10 m.

Table 6. Locations and sizes of plots in Salix boothii stands.

Salix boothii/Poa pratensis community

Plot 133. Battle Creek, about 2 miles downstream from the crossing of Forest Road 807; T13N, R87W, Sec 20, SW1/4 SE1/4. Plot size 20 m x 20 m.

Plot 181. Battle Creek, about 3 miles downstream from the crossing of Forest Road 807 and about 0.5 mile upstream from the Forest boundary; T13N, R87W, Sec 30, NE1/4 SW1/4. Plot size 20 m x 20 m.

Plot 421. Big Sandstone Creek, about 4.5 miles downstream from the crossing of Forest Road 801 and about 3 miles upstream from the Forest boundary; T14N, R88W, Sec 28, NE1/4 NE1/4. Plot size 20 m x 20 m.

Other stand

Plot 331. Beaver Dam Park; T12N, R84W, Sec 11, SW1/4 SE1/4. Plot size 10 m x 10 m.

Table 7. Locations and sizes of plots in Alnus incana stands.

Alnus incana/Mesic Graminoid Community

Plot 131. Battle Creek, about 1.5 miles downstream from the crossing of Forest Road 807; T13N, R87W, Sec 20, SW1/4 SE1/4). Plot size 10 m x 10 m.

Plot 162. Battle Creek, about 2 miles downstream from the crossing of Forest Road 807; T13N, R87W, Sec 29, NW1/4 NW1/4). Plot size 10 m x 10 m.

Plot 411. Big Sandstone Creek, about 3.5 miles downstream from the crossing of Forest Road 801; T14N, R88W, Sec 22, SE1/4 SE1/4). Plot size 20 m x 20 m.

Plot 811. Big Creek, about 1.5 miles downstream from the confluence of the North, Middle, and South Forks, and about 1 mile upstream from the Forest boundary; T13N, R81W, Sec 31, SW1/4 SE1/4. Plot size 20 m x 5 m.

Other Alnus incana stand

Plot 911. Medicine Bow River, about 1.25 miles upstream from Stillwater Park; T17N, R80W, Sec 14, NW1/4 NW1/4). Plot size 20 m x 5 m.

Table 8. Locations and sizes of plots in the stand of the Salix wolfii/Deschampsia caespitosa community.

These two plots are from one stand.

Plot 011. South end of Rock Creek Park, about 0.35 mile east of Forest Road 101; T17N, R78W, Sec 32, NE1/4 SW1/4. Plot size 10 m x 10 m.

Plot 012. South end of Rock Creek Park, about 0.35 mile east of Forest Road 101; T17N, R78W, Sec 32, NE1/4 SW1/4. Plot size 10 m x 10 m.

Table 9. Locations and sizes of plots in stands of the Artemisia cana/Poa pratensis community.

Plot 122. Battle Creek, about 0.75 mile downstream from the crossing of Forest Road 807; T13N, R87W, Sec 21, NE1/4 SW1/4. Plot size 40 m x 40 m.

Plot 161. Battle Creek, about 2 miles downstream from the crossing of Forest Road 807; T13N, R87W, Sec 29, NW1/4 NW1/4. Plot size 20 m x 20 m.

Plot 412. Big Sandstone Creek, about 3.5 miles downstream from the crossing of Forest Road 801; T14N, R88W, Sec 22, SE1/4. Plot size 20 m x 20 m.

Plot 612. Middle Fork of Big Creek, in Cunningham Park about 500 feet upstream from the confluence with the North Fork of Big Creek; T12N, R81W, Sec 7, NW1/4 NW1/4. Plot size 20 m x 20 m.

Table 10. Locations and sizes of plots in stands of the Carex rostrata community.

Plot 321. North end of Beaver Dam Park; T12N, R84W, Sec 12, NW1/4 SW1/4. Plot size 10 m x 10 m.

Plot 711. South Fork of Big Creek, in Holroyd Park about 0.25 mile upstream from the confluence with the Middle Fork of Big Creek; T12N, R81W, Sec 7, NE1/4 NW1/4. Plot size 20 m x 5 m.

The following 2 plots are from one stand.

Plot 211. North Soldier Creek, at southwest edge of park and about 0.5 mile upstream from Forest Road 550; T13N, R84W, Sec 20, SW1/4 NE1/4. Plot size 10 m x 10 m.

Plot 212. North Soldier Creek, at southwest edge of park and about 0.5 mile upstream from Forest Road 550; T13N, R84W, Sec 20, SW1/4 NE1/4. Plot size 10 m x 10 m.

Table 11. Location and size of the plot in the stand of the Carex aquatilis community.

Plot 123. Battle Creek, about 0.75 mile downstream from the crossing of Forest Road 807; T13N, R87W, Sec 21, NE1/4 SW1/4). Plot size 20 m x 5 m.

Table 12. Location and size of the plot in the stand of the Carex microptera community.

Plot 332. Beaver Dam Park; T12N, R84W, Sec 11, SW1/4 SE1/4. Plot size 10 m x 10 m.

Table 13. Location and size of the plot in the stand of the Juncus balticus community.

Plot 191. Battle Creek, about 3 miles downstream from the crossing of Forest Road 807; T13N, R87W, Sec 30, SE1/4 NE/4. Plot size 20 m x 20 m.

Table 14. Locations and sizes of plots in unclassified stands.

Plot 441. Big Sandstone Creek, about 3.5 miles downstream from the crossing of Forest Road 801; T14N, R88W, Sec 22, SE1/4 SE1/4. Plot size 20 m x 20 m.

Plot 821. Big Creek, about 0.5 mile downstream from the confluence of the North, Middle, and South Forks; T12N, R81W, Sec 6, NE1/4 SW1/4. Plot size 20 m x 5 m.

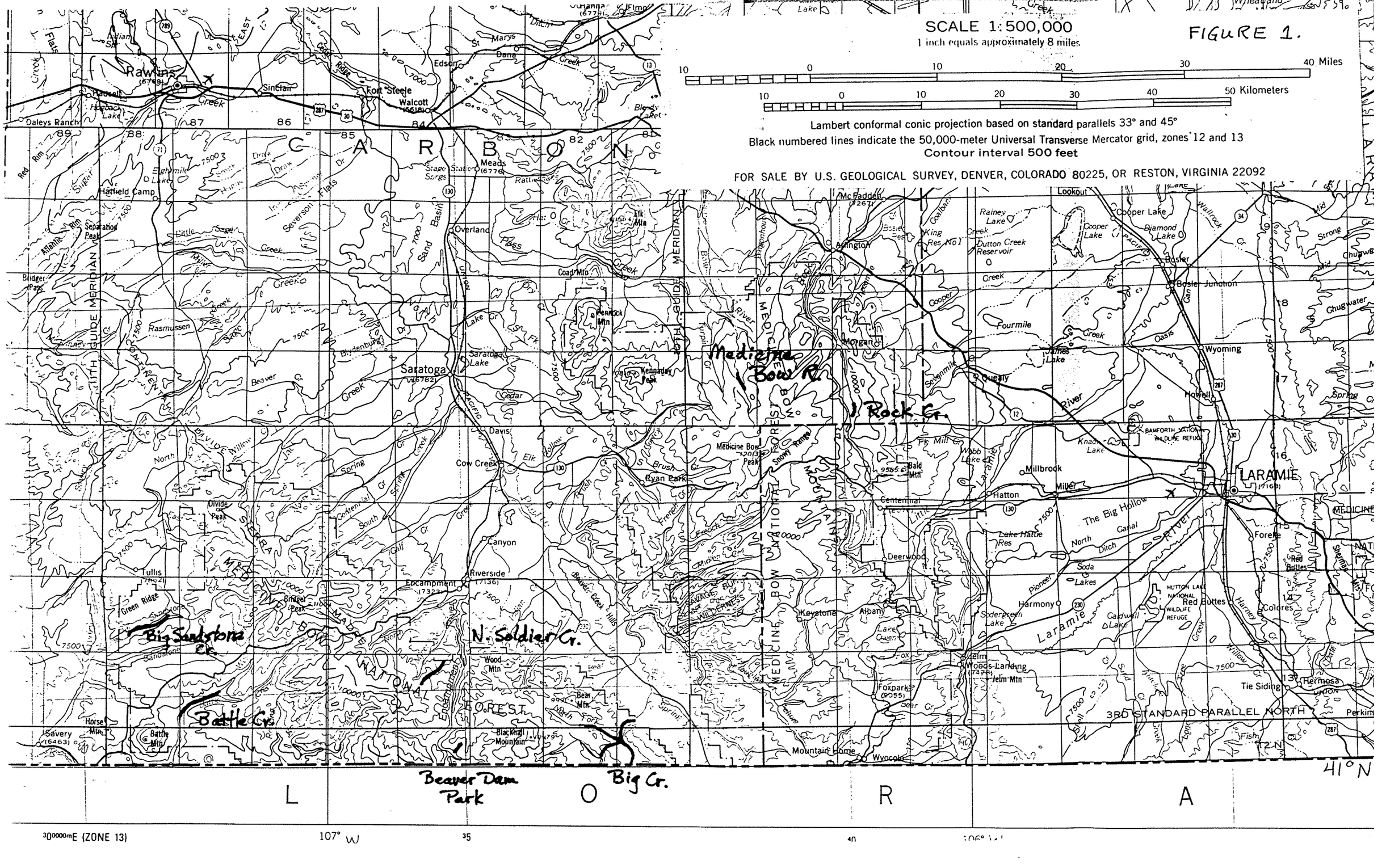
Plot 322. North end of Beaver Dam Park; T12N, R84W, Sec 12, NW1/4 SW1/4. Plot size 10 m x 10 m.

Plot 632. Middle Fork of Big Creek, about the middle of the canyon between Big Creek Park and Cunningham Park; T12N, R82W, Sec 12, NW1/4 SE1/4. Plot size 10 m x 10 m.

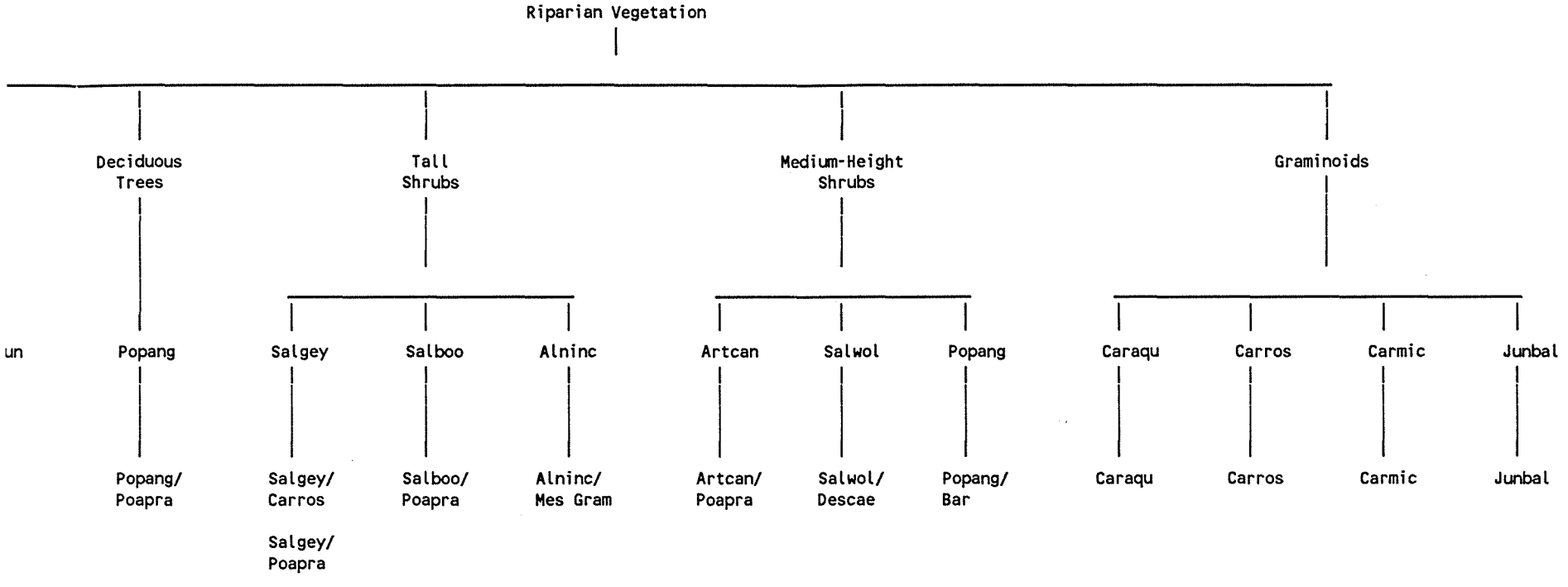
Plot 621. Middle Fork of Big Creek, about 0.75 mile upstream from the confluence with the North Fork of Big Creek; T12N, R82W, Sec 12, NE1/4 SE1/4. Plot size 40 m x 10 m.

Plot 111. Battle Creek, about 0.5 mile downstream from the crossing of Forest Road 807; T13N, R87W, Sec 21, NW1/4 SE1/4. Plot size 20 m x 20 m.

Figure 1. General locations of streams with sampling sites.



es.



lder)
agebrush)
edge)
wing sedge)
edge)
scented bedstraw)
rush

Piceng = Picea engelmannii (Engelmann spruce)
Picpun = Picea pungens (blue spruce)
Popang = Populus angustifolia (narrowleaf cottonwood)
Salboo = Salix boothii (Booth willow)
Salgey = Salix geyeriana (Geyer willow)
Salwol = Salix wolfii (Wolf willow)

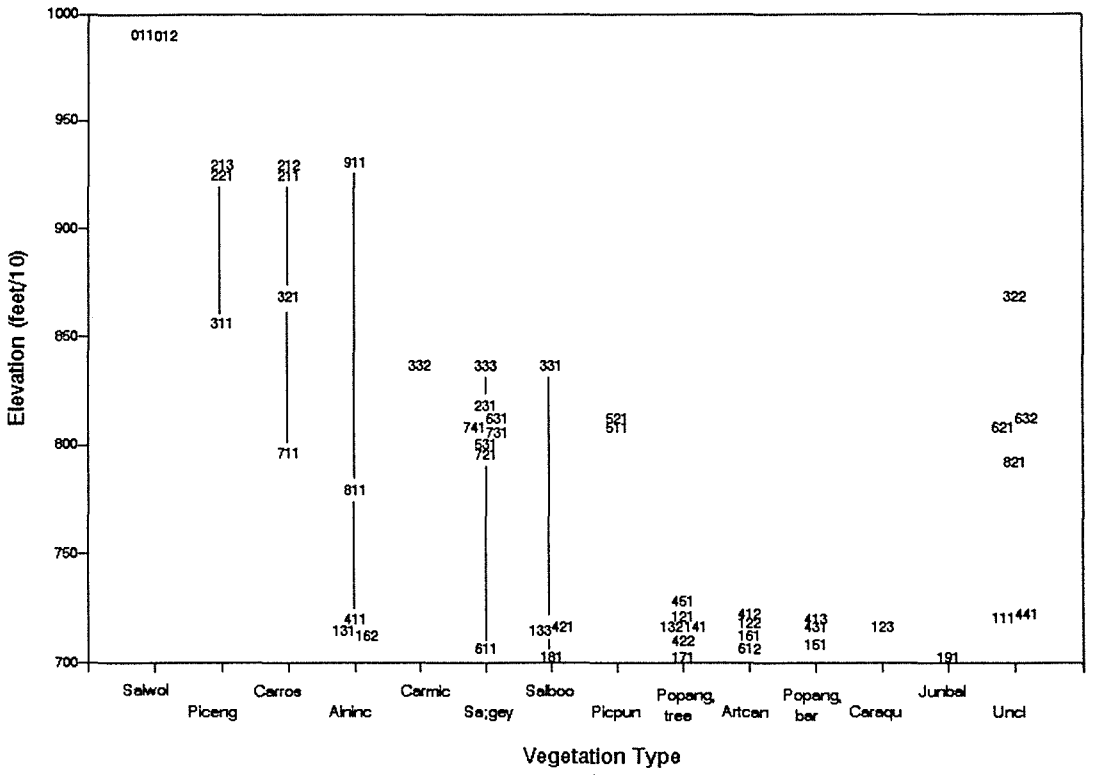


Figure 3. Elevation of each plot of every vegetation type. Each plot is represented by its 3-digit number. Acronyms represent the following vegetation types: **Uncl** = unclassified stands; **Piceng** = the Picea engelmannii/Galium trifidum community; **Picpun** = the Picea pungens series; **Popang, tree** = the Populus angustifolia/Poa pratensis community; **Popang, bar** = the Populus angustifolia Recent Alluvial Bar community; **Salgey** = the Salix geyeriana/Carex rostrata community and the S. geyeriana/Poa pratensis community; **Salboo** = the Salix boothii/Poa pratensis community and the unclassified Salix boothii stand; **Alninc** = Alnus incana/Mesic Graminoid community and the unclassified Alnus incana stand; **Salwol** = the Salix wolfii/Deschampsia caespitosa community; **Artcan** = the Artemisia cana/Poa pratensis community; **Carros** = the Carex rostrata community; **Caraqu** = the Carex aquatilis community; **Carmic** = the Carex microptera community; **Junbal** = the Juncus balticus community. This figure only displays the variation in sampled plots. Accurate ranges of variation for each community requires sampling of more stands.

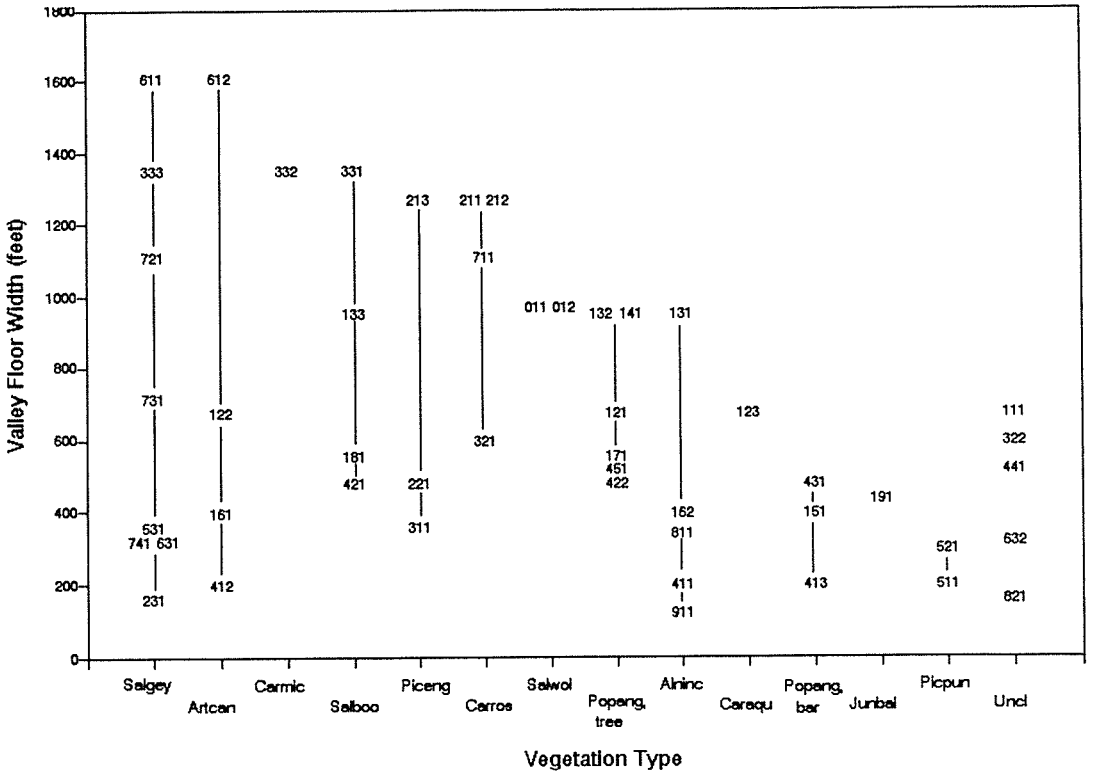


Figure 4. Relationship of each plot of every vegetation type to the width of the valley floor in the region of the stand. Each plot is represented by its 3-digit number. Acronyms represent the following vegetation types: **Uncl** = unclassified stands; **Piceng** = the Picea engelmannii/Galium trifidum community; **Picpun** = the Picea pungens series; **Popang, tree** = the Populus angustifolia/Poa pratensis community; **Popang, bar** = the Populus angustifolia Recent Alluvial Bar community; **Salgey** = the Salix geyeriana/Carex rostrata community and the S. geyeriana/Poa pratensis community; **Salboo** = the Salix boothii/Poa pratensis community and the unclassified Salix boothii stand; **Alninc** = Alnus incana/Mesic Graminoid community and the unclassified Alnus incana stand; **Salwol** = the Salix wolfii/Deschampsia caespitosa community; **Artcan** = the Artemisia cana/Poa pratensis community; **Carros** = the Carex rostrata community; **Caraqu** = the Carex aquatilis community; **Carmic** = the Carex microptera community; **Junbal** = the Juncus balticus community. This figure only displays the variation in sampled plots. Accurate ranges of variation for each community requires sampling of more stands.

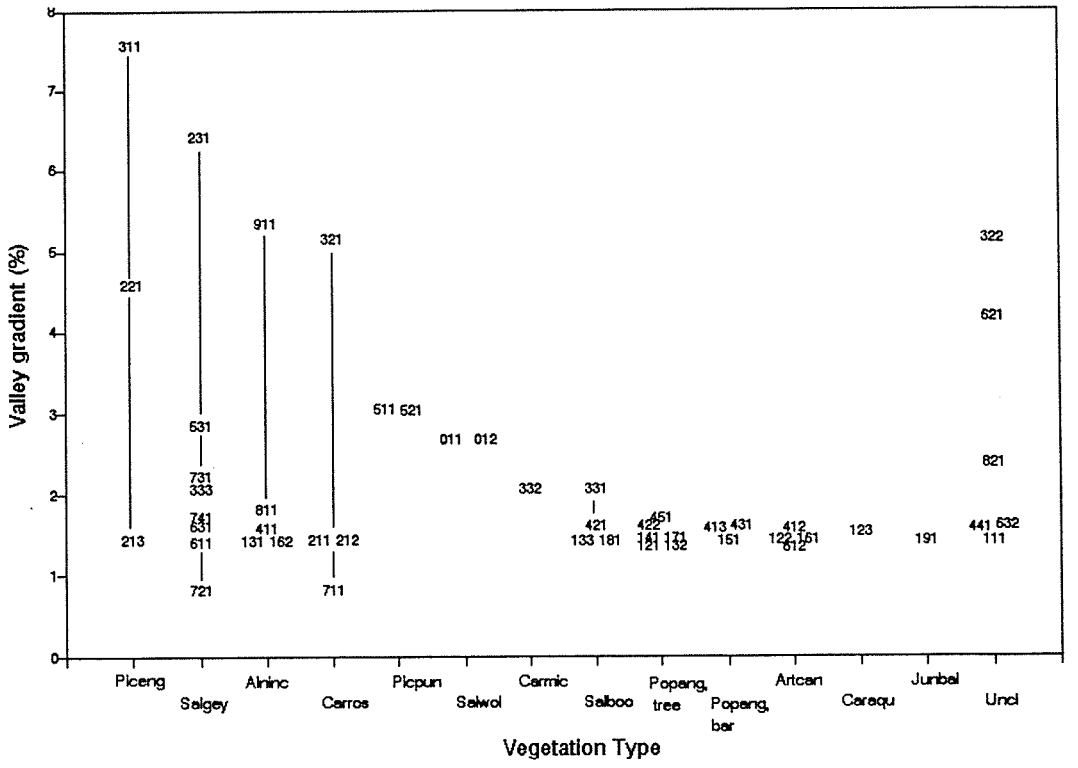


Figure 5. Relationship of each plot of every vegetation type to the gradient of the valley in the region of the stand. Each plot is represented by its 3-digit number. Acronyms represent the following vegetation types: **Uncl** = unclassified stands; **Piceng** = the Picea engelmannii/Galium trifidum community; **Picpun** = the Picea pungens series; **Popang, tree** = the Populus angustifolia/Poa pratensis community; **Popang, bar** = the Populus angustifolia Recent Alluvial Bar community; **Salgey** = the Salix geyeriana/Carex rostrata community and the S. geyeriana/Poa pratensis community; **Salboo** = the Salix boothii/Poa pratensis community and the unclassified Salix boothii stand; **Alninc** = Alnus incana/Mesic Graminoid community and the unclassified Alnus incana stand; **Salwol** = the Salix wolfii/Deschampsia caespitosa community; **Artcan** = the Artemisia cana/Poa pratensis community; **Carros** = the Carex rostrata community; **Caraqu** = the Carex aquatilis community; **Carmic** = the Carex microptera community; **Junbal** = the Juncus balticus community. This figure only displays the variation in sampled plots. Accurate ranges of variation for each community requires sampling of more stands.

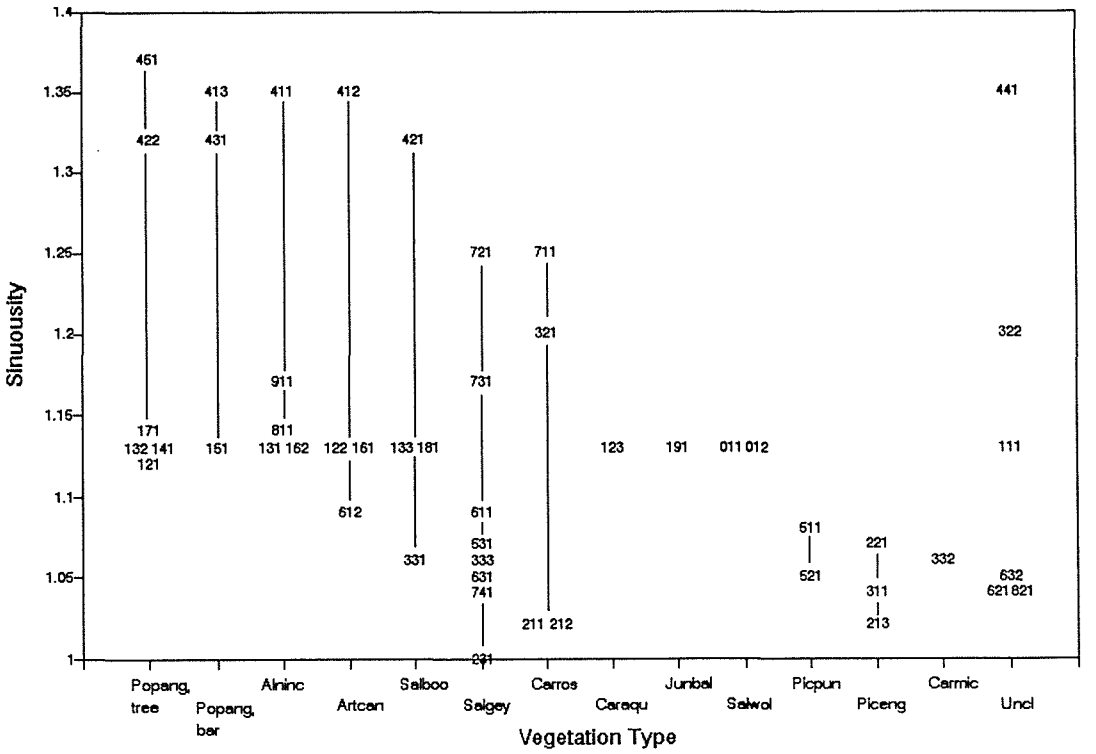


Figure 6. Relationship of each plot of every vegetation type to the sinuousity of the stream in the region of the stand. Each plot is represented by its 3-digit number. Acronyms represent the following vegetation types: **Uncl** = unclassified stands; **Piceng** = the Picea engelmannii/Galium trifidum community; **Picpun** = the Picea pungens series; **Popang, tree** = the Populus angustifolia/Poa pratensis community; **Popang, bar** = the Populus angustifolia Recent Alluvial Bar community; **Salgey** = the Salix geyeriana/Carex rostrata community and the S. geyeriana/Poa pratensis community; **Salboo** = the Salix boothii/Poa pratensis community and the unclassified Salix boothii stand; **Alninc** = Alnus incana/Mesic Graminoid community and the unclassified Alnus incana stand; **Salwol** = the Salix wolfii/Deschampsia caespitosa community; **Artcan** = the Artemisia cana/Poa pratensis community; **Carros** = the Carex rostrata community; **Caraqu** = the Carex aquatilis community; **Carmic** = the Carex microptera community; **Junbal** = the Juncus balticus community. This figure only displays the variation in sampled plots. Accurate ranges of variation for each community requires sampling of more stands.

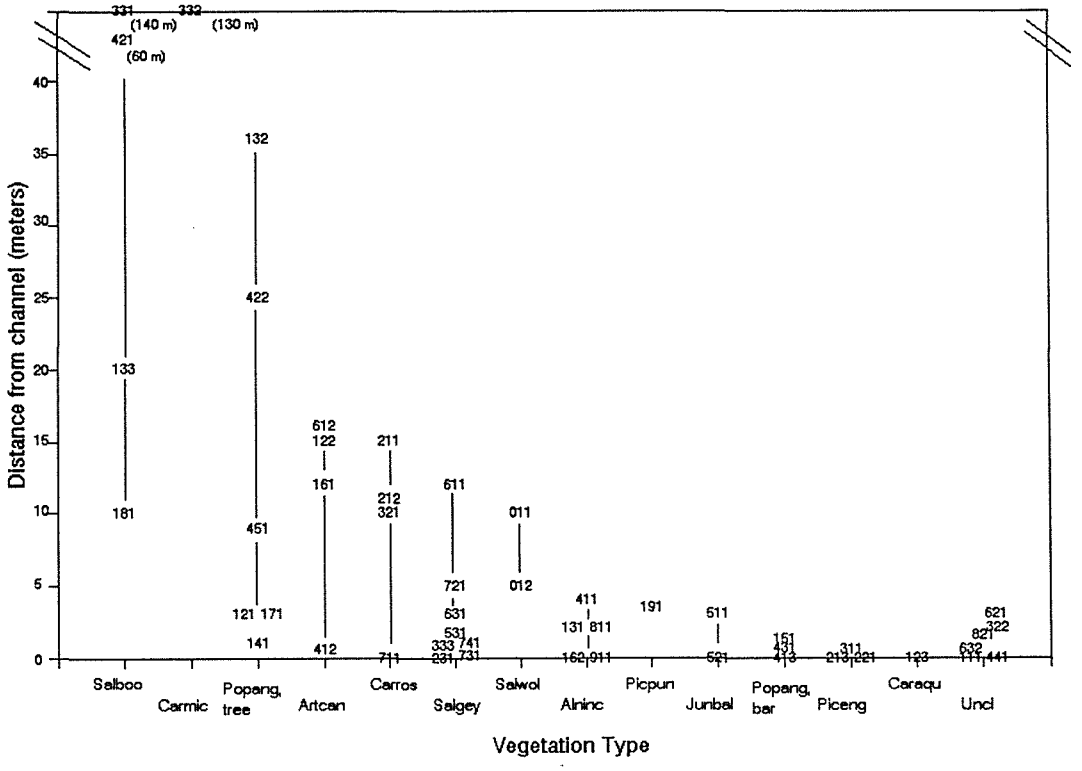


Figure 7. Distance of each plot every vegetation type from the nearest stream channel. Each plot is represented by its 3-digit number. Acronyms represent the following vegetation types: **Uncl** = unclassified stands; **Piceng** = the Picea engelmannii/Galium trifidum community; **Picpun** = the Picea pungens series; **Popang, tree** = the Populus angustifolia/Poa pratensis community; **Popang, bar** = the Populus angustifolia Recent Alluvial Bar community; **Salgey** = the Salix geyeriana/Carex rostrata community and the S. geyeriana/Poa pratensis community; **Salboo** = the Salix boothii/Poa pratensis community and the unclassified Salix boothii stand; **Alninc** = Alnus incana/Mesic Graminoid community and the unclassified Alnus incana stand; **Salwol** = the Salix wolfii/Deschampsia caespitosa community; **Artcan** = the Artemisia cana/Poa pratensis community; **Carros** = the Carex rostrata community; **Caraqu** = the Carex aquatilis community; **Carmic** = the Carex microptera community; **Junbal** = the Juncus balticus community. This figure only displays the variation in sampled plots. Accurate ranges of variation for each community requires sampling of more stands.

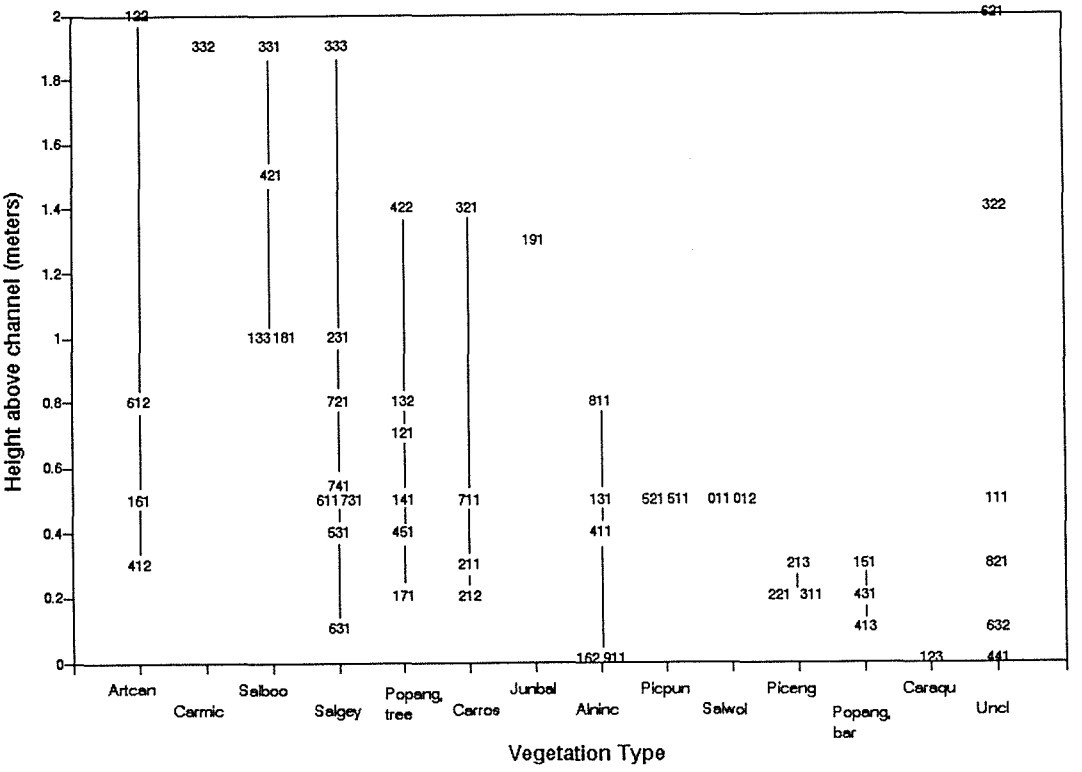


Figure 8. Height of each plot of every vegetation type above the nearest stream channel. Each plot is represented by its 3-digit number. Acronyms represent the following vegetation types: **Uncl** = unclassified stands; **Piceng** = the Picea engelmannii/Galium trifidum community; **Picpun** = the Picea pungens series; **Popang, tree** = the Populus angustifolia/Poa pratensis community; **Popang, bar** = the Populus angustifolia Recent Alluvial Bar community; **Salgey** = the Salix geyeriana/Carex rostrata community and the S. geyeriana/Poa pratensis community; **Salboo** = the Salix boothii/Poa pratensis community and the unclassified Salix boothii stand; **Alninc** = Alnus incana/Mesic Graminoid community and the unclassified Alnus incana stand; **Salwol** = the Salix wolfii/Deschampsia caespitosa community; **Artcan** = the Artemisia cana/Poa pratensis community; **Carros** = the Carex rostrata community; **Caraqu** = the Carex aquatilis community; **Carmic** = the Carex microptera community; **Junbal** = the Juncus balticus community. This figure only displays the variation in sampled plots. Accurate ranges of variation for each community requires sampling of more stands.

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State University,

Appendix I. Tables of canopy cover in vegetation plots.

Table I-1. Absolute canopy cover (and relative canopy cover) for each species in plots of the Picea engelmannii/Galium triflorum community and the Picea pungens series. Relative canopy cover for species A in a plot = (cover of species A in the plot/cover of all species in the plot).

	Plots				
	P. engelmannii			P. pungens	
	2	2	3	5	5
	1	2	1	1	2
SPECIES	3	1	1	1	1
TREES					
Abies lasiocarpa	20 (15)	40 (30)	3 (3)		3 (2)
Picea engelmannii	30 (22)	30 (23)	40 (34)		
Picea pungens				20 (16)	40 (21)
Pinus contorta			3 (3)	30 (23)	30 (16)
Populus angustifolia					
Populus tremuloides					
TALL SHRUBS AND SAPLINGS					
Alnus incana				3 (2)	20 (10)
Amelanchier alnifolia					
Betula occidentalis					
Populus angustifolia sapling					
Populus tremuloides sapling					
Salix bebbiana				10 (8)	
Salix boothii					3 (2)
Salix exigua					
Salix geyeriana					10 (5)
Salix lasiandra				10 (8)	
Salix spp.					
MEDIUM SHRUBS					
Artemisia cana					
Artemisia tridentata					
Chrysothamnus nauseosus					
Chrysothamnus parryi					
Cornus sericea					
Juniperus communis				1 (1)	1 (1)
Lonicera involucrata	3 (2)		1 (1)		3 (2)
Potentilla fruticosa				3 (2)	3 (2)
Ribes inerme					
Ribes oxyacanthoides		3 (2)		1 (1)	
Ribes sp.					
Rosa woodsii			1 (1)	1 (1)	3 (2)
Rubus idaeus					
Salix planifolia	3 (2)				
Salix wolfii					
Shepherdia canadensis					3 (2)
Symphoricarpos occidentalis					
Symphoricarpos oreophilus					
LOW SHRUBS AND SEEDLINGS					
Arctostaphylos uva-ursi					1 (1)
Mahonia repens					
Picea engelmanii seedling					
Populus angustifolia seedling					
Vaccinium scoparium	10 (7)	10 (8)	10 (9)		
GRAMINOIDS					
Agropyron spp.					
Agropyron subsecundum					

	Plots				
	P. engelmannii			P. pungens	
	2 1 3	2 2 1	3 1 1	5 1 1	5 2 1
SPECIES					
Agropyron trachycaulum					
Agrostis exarata					
Agrostis scabra	1 (1)		1 (1)		
Bromus anomalus					
Bromus ciliatus			1 (1)		
Bromus sp.					
Calamagrostis canadensis		3 (2)	1 (1)	3 (2)	
Carex aquatilis					
Carex aurea					
Carex athrostachya					
Carex gynocrates					
Carex lanuginosa					
Carex microptera					
Carex pensylvanica	20 (15)	10 (8)	1 (1)		
Carex rostrata	3 (2)				
Carex spp.			3 (3)	10 (8)	10 (5)
Danthonia intermedia					
Deschampsia caespitosa	3 (2)				
Eleocharis palustris					
Elymus glaucus					
Elymus x macounii			3 (3)		3 (2)
Elymus sp.					
Festuca idahoensis					
Festuca saximontana					
Glyceria striata	10 (7)		1 (1)		
Hordeum brachyantherum					
Juncus balticus	1 (1)		1 (1)	1 (1)	1 (1)
Juncus halleyi & J. traceyi					
Juncus longistylus & J. ensifolius					
Juncus mertensianus					
Juncus sp.					
Koeleria macrantha					
Muhlenbergia richardsonis					
Phleum alpinum					
Phleum pratense*			1 (1)		
Phleum sp.					
Poa interior					
Poa juncifolia					
Poa palustris*					
Poa pratensis*					
Poa sp.			1 (1)		
Stipa lettermanii					
Stipa nelsonii					
Trisetum spicatum					
Trisetum wolfii					
FORBS					
Achillea millefolium			1 (1)	1 (1)	1 (1)
Aconitum columbianum					
Actaea rubra					
Agoseris glauca					
Allium spp.				1 (1)	
Anaphalis margaritacea					
Androsace filiformis					
Androsace septentrionalis					
Antennaria microphylla			1 (1)	3 (2)	1 (1)

	Plots				
	P. engelmannii			P. pungens	
	2 1 3	2 2 1	3 1 1	5 1 1	5 2 1
SPECIES					
Antennaria umbrinella			1 (1)		
Arnica chamissonis					
Arnica mollis			1 (1)	1 (1)	
Artemisia ludoviciana					
Aster adscendens					
Aster foliaceus					
Aster occidentalis			1 (1)		
Astragalus alpinus				1 (1)	1 (1)
Caltha leptosepala	10 (7)	3 (2)			
Campanula rotundifolia			1 (1)		1 (1)
Caradmine breweri					
Cerastium arvense		1 (1)			
Cerastium fontanum					
Cerastium nutans					
Cirsium arvense*					
Cirsium spp.					
Cirsium vulgare*					
Conioselinum scopulorum	1 (1)		1 (1)	1 (1)	1 (1)
Descurainia incana					
Dodecatheon pulchellum				3 (2)	
Epilobium angustifolium	1 (1)	1 (1)	1 (1)	1 (1)	
Epilobium brachycarpum					
Epilobium ciliatum			1 (1)		
Equisetum arvense					
Equisetum laevigatum	3 (2)	3 (2)	1 (1)	1 (1)	10 (5)
Equisetum sp.					1 (1)
Erigeron glabellus					
Erigeron speciosus	3 (2)	3 (2)			
Erigeron ursinus					
Fragaria virginiana					
Frasera speciosa			1 (1)	1 (1)	10 (5)
Galium aparine					
Galium boreale			1 (1)		1 (1)
Galium trifidum	1 (1)	1 (1)			
Geranium richardsonii			1 (1)	3 (2)	3 (2)
Geum aleppicum	1 (1)			3 (2)	1 (1)
Geum macrophyllum					
Heracleum sphondylium					1 (1)
Hypericum formosum					
Ligusticum porteri					
Ligusticum tenuifolium					
Lupinus argenteus			10 (9)		
Maianthemum stellatum	3 (2)			3 (2)	3 (2)
Medicago lupulina*					
Mentha arvensis					
Mertensia ciliata & M. arizonica					
Mitella pentandra		3 (2)	3 (3)		
Orthilia secunda		10 (8)	1 (1)		10 (5)
Osmorhiza spp.	1 (1)		1 (1)	3 (2)	10 (5)
Oxypolis fendleri	3 (2)		3 (3)		
Pedicularis groenlandica					
Perideridia montana					
Plantago major*					
Polygonum bistortoides					
Polygonum douglasii					
Polygonum viviparum				1 (1)	

	Plots				
	P. engelmannii			P. pungens	
	2	2	3	5	5
	1	2	1	1	2
SPECIES	3	1	1	1	1
Potentilla anserina					
Potentilla diversifolia					
Potentilla gracilis				1 (1)	
Prunella vulgaris			1 (1)		
Ranunculus spp.			1 (1)		
Rudbeckia laciniata					
Rumex crispus*					
Saxifraga odontoloma		3 (2)	1 (1)		
Senecio eremophilus					
Senecio triangularis	3 (2)	3 (2)	3 (3)	3 (2)	
Sidalcea neomexicana					
Solidago canadensis					
Solidago gigantea					
Solidago multiradiata					
Stellaria borealis					
Taraxacum officinale*	3 (2)	1 (1)	1 (1)	3 (2)	3 (2)
Thalictrum fendleri					
Thalictrum sparsiflorum					
Thalspi arvense*					
Tragopogon dubius*					
Trifolium longipes					1 (1)
Trifolium pratense*				1 (1)	
Trifolium repens*					
Trollius laxus		1 (1)			
Urtica dioica					
Veronica wormskjoldii					
Veronica serpyllifolia					
Vicia americana					
Viola sp.		3 (2)			
Total tree cover	50	60	40	40	70
Total shrub cover	10	3	12	30	40
Tall			1	23	30
Medium	10	3	1	5	10
Low			10		1
Total graminoid cover	40	15	15	10	15
Total forb cover	35	35	40	30	25
Ground cover					
Bare soil	3	3	40	1	1
Gravel				1	
Rock		3	3	1	
Litter	80	30	40	90	80
Wood	3	10	3	1	1
Moss	3	50	1	1	1

* Exotic species

Table I-2. Absolute canopy cover (and relative canopy cover) for each species in plots of the Populus angustifolia/Poa pratensis community. Relative canopy cover for species A in a plot = (cover of species A in the plot/cover of all species in the plot).

	Plots					
SPECIES	1 2 1	1 3 2	1 4 1	1 7 1	4 2 2	4 5 1
TREES						
Abies lasiocarpa						
Picea engelmannii						
Picea pungens	30 (21)				1 (1)	
Pinus contorta						
Populus angustifolia	60 (42)	40 (19)	98 (50)	80 (41)	70 (36)	40 (14)
Populus tremuloides						
TALL SHRUBS AND SAPLINGS						
Alnus incana		3 (2)		1 (1)	1 (1)	
Amelanchier alnifolia	1 (1)				1 (1)	
Betula occidentalis						
Populus angustifolia sapling						
Populus tremuloides sapling						
Salix bebbiana						
Salix boothii		20 (9)				
Salix exigua		1 (1)				
Salix geyeriana						
Salix lasiandra						
Salix spp.						
MEDIUM SHRUBS						
Artemisia cana			3 (2)		1 (1)	1 (0.4)
Artemisia tridentata	2					
Chrysothamnus nauseosus					1 (1)	
Chrysothamnus parryi			1 (1)			
Cornus sericea						
Juniperus communis	10 (7)			1 (1)		
Lonicera involucrata	3 (2)					
Potentilla fruticosa			1 (1)			
Ribes inerme	1 (1)				1 (1)	
Ribes oxyacanthoides						
Ribes sp.						
Rosa woodsii	1 (1)		1 (1)			
Rubus idaeus	1 (1)					
Salix planifolia						
Salix wolfii						
Shepherdia canadensis						
Symphoricarpos occidentalis	1 (1)				1 (1)	1 (0.4)
Symphoricarpos oreophilus			1 (1)			
LOW SHRUBS AND SEEDLINGS						
Arctostaphylos uva-ursi						
Mahonia repens						
Picea engelmanii seedling						
Populus angustifolia seedling		3 (2)				3 (1)
Vaccinium scoparium						
GRAMINOIDS						
Agropyron spp.						
Agropyron subsecundum				10 (5)	1 (1)	1 (0.4)

SPECIES	Plots 1 2 1	1 3 2	1 4 1	1 7 1	4 2 2	4 5 1
Agropyron trachycaulum		3 (2)	3 (2)			
Agrostis exarata					3 (2)	
Agrostis scabra	1 (1)	10 (5)				1
Bromus anomalus			3 (2)	3 (2)	10 (5)	3 (1)
Bromus ciliatus						
Bromus sp.	1 (1)					
Calamagrostis canadensis						
Carex aquatilis						
Carex aurea		3 (2)				
Carex athrostachya						
Carex gynocrates						
Carex lanuginosa						
Carex microptera		10 (5)				
Carex pensylvanica						
Carex rostrata						
Carex spp.	1 (1)	3 (2)	3 (2)	10 (5)	10 (5)	1 (0.4)
Danthonia intermedia						
Deschampsia caespitosa						1
Eleocharis palustris		3 (2)				
Elymus glaucus						
Elymus x macounii	1 (1)		1 (1)		3 (2)	3 (1)
Elymus sp.						
Festuca idahoensis			1 (1)			
Festuca saximontana						
Glyceria striata				1 (1)	3 (2)	
Hordeum brachyantherum						
Juncus balticus	1 (1)	30 (14)	1 (1)			
Juncus halleyi & J. traceyi						
Juncus longistylus & J. ensifolius		1 (1)				
Juncus mertensianus						
Juncus sp.		1 (1)				
Koeleria macrantha						
Muhlenbergia richardsonis						
Phleum alpinum						
Phleum pratense*		1 (1)		3 (2)		
Phleum sp.						
Poa interior						
Poa juncifolia			10 (5)	1 (1)		
Poa palustris*	1 (1)					
Poa pratensis*	1 (1)	40 (19)	50 (26)	70 (36)	40 (20)	20 (7)
Poa sp.						
Stipa lettermanii						
Stipa nelsonii						
Trisetum spicatum						
Trisetum wolfii						
FORBS						
Achillea millefolium	1 (1)	3 (2)	1 (1)	1 (1)	3 (2)	
Aconitum columbianum						1 (0.4)
Actaea rubra						
Agoseris glauca						
Allium spp.	1 (1)				1 (1)	
Anaphalis margaritacea	1 (1)					
Androsace filiformis						
Androsace septentrionalis				1 (1)		
Antennaria microphylla						
Antennaria umbrinella						

SPECIES	Plots 1 2 1	1 3 2	1 4 1	1 7 1	4 2 2	4 5 1
Arnica chamissonis						
Arnica mollis						3 (1)
Artemisia ludoviciana			1 (1)			
Aster adscendens						
Aster foliaceus					1 (1)	
Aster occidentalis						
Astragalus alpinus						
Caltha leptosepala						
Campanula rotundifolia						
Caradmine breweri						
Cerastium arvense						
Cerastium fontanum						
Cerastium nutans						
Cirsium arvense*			1 (1)	3 (2)	4 (2)	
Cirsium spp.						1 (0.4)
Cirsium vulgare*						
Conioselinum scopulorum						
Descurainia incana						
Dodecatheon pulchellum						
Epilobium angustifolium						
Epilobium brachycarpum						
Epilobium ciliatum						
Equisetum arvense						
Equisetum laevigatum		1 (1)	2	1 (1)		
Equisetum sp.						
Erigeron glabellus		10 (5)				
Erigeron speciosus	1				1 (1)	
Erigeron ursinus						
Fragaria virginiana						
Frasera speciosa	3 (2)					
Galium aparine	1 (1)					
Galium boreale	3 (2)	1 (1)				
Galium trifidum				1		
Geranium richardsonii	1 (1)			3 (2)		10 (3)
Geum aleppicum	1 (1)				1 (1)	
Geum macrophyllum						
Heracleum sphondylium	1 (1)					
Hypericum formosum					1 (1)	
Ligusticum porteri	1 (1)					
Ligusticum tenuifolium						
Lupinus argenteus						
Maianthemum stellatum			1 (1)	1 (1)	3 (2)	1 (0.4)
Medicago lupulina*						
Mentha arvensis						
Mertensia ciliata & M. arizonica	1 (1)					
Mitella pentandra						
Orthilia secunda	1					
Osmorhiza spp.	3 (2)				10 (5)	3 (1)
Oxypolis fendleri						
Pedicularis groenlandica						
Perideridia montana						
Plantago major*						
Polygonum bistortoides						
Polygonum douglasii	1 (1)		1 (1)			
Polygonum viviparum						
Potentilla anserina						
Potentilla diversifolia						

SPECIES	Plots 1 2 1	1 3 2	1 4 1	1 7 1	4 2 2	4 5 1
Potentilla gracilis	1 (1)	2 (1)			1 (1)	1 (0.4)
Prunella vulgaris		3 (2)				
Ranunculus spp.						
Rudbeckia laciniata	1 (1)					
Rumex crispus*						
Saxifraga odontoloma						
Senecio eremophilus						
Senecio triangularis						
Sidalcea neomexicana		1 (1)				1 (0.4)
Solidago canadensis						
Solidago gigantea						
Solidago multiradiata						
Stellaria borealis						
Taraxacum officinale*	3 (2)	10 (5)	3 (2)	3 (2)	20 (10)	20 (7)
Thalictrum fendleri	1 (1)					
Thalictrum sparsiflorum						
Thalspi arvense*			1 (1)			
Tragopogon dubius*						
Trifolium longipes						
Trifolium pratense*						20 (7)
Trifolium repens*		1 (1)			3 (2)	
Trollius laxus						
Urtica dioica				1 (1)		
Veronica wormskjoldii						
Veronica serpyllifolia						
Vicia americana	1 (1)	1 (1)			1 (1)	10 (3)
Viola sp.	1 (1)	3 (2)				
Total tree cover	80	40	98	80	70	40
Total shrub cover	10	20	7	5	5	5
Tall	3	20	7	1	2	2
Medium	16			1	4	3
Low		3		3		
Total graminoid cover	3	90	50	80	50	20
Total forb cover	20	30	10	10	40	40
Ground cover						
Bare soil	1	1	3	3	1	1
Gravel		1	1		1	1
Rock		1	1		1	1
Litter	80	85	90	90	85	85
Wood	20	1	10	3	10	10
Moss	1	1	1	1	1	

* Exotic species

Table I-3. Absolute canopy cover (and relative canopy cover) for each species in plots of the Populus angustifolia Recent Alluvial Bar vegetation type. Relative canopy cover for species A in a plot = (cover of species A in the plot/cover of all species in the plot).

SPECIES	Plots 4 1 3	4 3 1	1 5 1
TREES			
Abies lasiocarpa			
Picea engelmannii			
Picea pungens			
Pinus contorta			
Populus angustifolia			
Populus tremuloides			
TALL SHRUBS AND SAPLINGS			
Alnus incana		1 (1)	1 (1)
Amelanchier alnifolia			
Betula occidentalis			
Populus angustifolia sapling			40 (27)
Populus tremuloides sapling			
Salix bebbiana			
Salix boothii			1 (1)
Salix exigua			1 (1)
Salix geyeriana			
Salix lasiandra			
Salix spp.	1 (1)		
MEDIUM SHRUBS			
Artemisia cana		1 (1)	
Artemisia tridentata	1 (1)	1 (1)	
Chrysothamnus nauseosus		1 (1)	
Chrysothamnus parryi			
Cornus sericea			1 (1)
Juniperus communis			
Lonicera involucrata			
Potentilla fruticosa			
Ribes inerme			
Ribes oxyacanthoides			
Ribes sp.			
Rosa woodsii	1 (1)		
Rubus idaeus			
Salix planifolia			
Salix wolfii			
Shepherdia canadensis			
Symphoricarpos occidentalis			
Symphoricarpos oreophilus			
LOW SHRUBS AND SEEDLINGS			
Arctostaphylos uva-ursi			
Mahonia repens			
Picea engelmanii seedling			
Populus angustifolia seedling	10 (13)	20 (27)	3 (2)
Vaccinium scoparium			
GRAMINOIDS			
Agropyron spp.			
Agropyron subsecundum		1 (1)	
Agropyron trachycaulum			

SPECIES	Plots 4 1 3	4 3 1	1 5 1
Agrostis exarata	3 (4)	10 (14)	
Agrostis scabra			3 (2)
Bromus anomalus			
Bromus ciliatus			
Bromus sp.			
Calamagrostis canadensis			
Carex aquatilis			
Carex aurea			
Carex athrostachya			
Carex gynocrates			3 (2)
Carex lanuginosa			
Carex microptera			
Carex pensylvanica			
Carex rostrata			
Carex spp.	1 (1)	1 (1)	
Danthonia intermedia			
Deschampsia caespitosa			
Eleocharis palustris			
Elymus glaucus			
Elymus x macounii			3 (2)
Elymus sp.			
Festuca idahoensis			
Festuca saximontana			
Glyceria striata	1 (1)	1 (1)	
Hordeum brachyantherum		1 (1)	
Juncus balticus			
Juncus halleyi & J. traceyi			
Juncus longistylus & J. ensifolius			
Juncus mertensianus			
Juncus sp.			
Koeleria macrantha			
Muhlenbergia richardsonis			
Phleum alpinum			
Phleum pratense*	3 (4)	1 (1)	3 (2)
Phleum sp.			
Poa interior			
Poa juncifolia			
Poa palustris*			10 (7)
Poa pratensis*	3 (4)		20 (14)
Poa sp.			
Stipa lettermanii			
Stipa nelsonii			
Trisetum spicatum			
Trisetum wolfii			
FORBS			
Achillea millefolium	3 (4)	1 (1)	3 (2)
Aconitum columbianum			
Actaea rubra			
Agoseris glauca			
Allium spp.			
Anaphalis margaritacea			
Androsace filiformis			
Androsace septentrionalis			
Antennaria microphylla			
Antennaria umbrinella			

SPECIES	Plots 4 1 3	4 3 1	1 5 1
Arnica chamissonis			
Arnica mollis			
Artemisia ludoviciana	1 (1)	1 (1)	
Aster adscendens			
Aster foliaceus			
Aster occidentalis	1 (1)	1 (1)	
Astragalus alpinus			
Caltha leptosepala			
Campanula rotundifolia			
Caradmine breweri			
Cerastium arvense			
Cerastium fontanum			
Cerastium nutans			1 (1)
Cirsium arvense*	1 (1)	1 (1)	
Cirsium spp.			
Cirsium vulgare*		1 (1)	
Conioselinum scopulorum			
Descurainia incana			
Dodecatheon pulchellum			
Epilobium angustifolium			
Epilobium brachycarpum	1 (1)	1 (1)	
Epilobium ciliatum			
Equisetum arvense			1 (1)
Equisetum laevigatum	10 (13)	3 (4)	
Equisetum sp.			
Erigeron glabellus			1 (1)
Erigeron speciosus			
Erigeron ursinus			
Fragaria virginiana			
Frasera speciosa	1 (1)		
Galium aparine			
Galium boreale			
Galium trifidum			
Geranium richardsonii			
Geum aleppicum		1 (1)	1 (1)
Geum macrophyllum			
Heracleum sphondylium			
Hypericum formosum			
Ligusticum porteri			
Ligusticum tenuifolium			
Lupinus argenteus		1 (1)	
Maianthemum stellatum			
Medicago lupulina*	1 (1)	1 (1)	
Mentha arvensis	1 (1)	1 (1)	3 (2)
Mertensia ciliata & M. arizonica			
Mitella pentandra			
Orthilia secunda			
Osmorhiza spp.			1 (1)
Oxypolis fendleri			
Pedicularis groenlandica			
Perideridia montana			
Plantago major*	1 (1)	1 (1)	1 (1)
Polygonum bistortoides			
Polygonum douglasii			
Polygonum viviparum			
Potentilla anserina		3 (4)	
Potentilla diversifolia			

SPECIES	Plots 4 1 3	4 3 1	1 5 1
Potentilla gracilis	1 (1)		
Prunella vulgaris	3 (4)	1 (1)	
Ranunculus spp.			
Rudbeckia laciniata	1 (1)	1 (1)	3 (2)
Rumex crispus*	3 (4)	1 (1)	
Saxifraga odontoloma			
Senecio eremophilus			10 (7)
Senecio triangularis			
Sidalcea neomexicana			
Solidago canadensis			
Solidago gigantea	1 (1)		
Solidago multiradiata			
Stellaria borealis			
Taraxacum officinale*	3 (4)	3 (4)	10 (7)
Thalictrum fendleri			
Thalictrum sparsiflorum			
Thalspi arvense*			
Tragopogon dubius*			
Trifolium longipes			
Trifolium pratense*	20 (26)	10 (14)	
Trifolium repens*			20 (14)
Trollius laxus			
Urtica dioica			1 (1)
Veronica wormskjoldii			
Veronica serpyllifolia			
Vicia americana	1 (1)	1 (1)	1 (1)
Viola sp.			
Total tree cover			
Total shrub cover	12	24	40
Tall	1	1	40
Medium	1	3	
Low	10	20	3
Total graminoid cover	11	10	40
Total forb cover	50	30	40
Ground cover			
Bare soil	1	1	30
Gravel	45	75	10
Rock	45	20	10
Litter	3	1	40
Wood	3	3	1
Moss	1		1

* Exotic species

Table I-4. Absolute canopy cover (and relative canopy cover) for each species in plots of the Salix geyeriana/Poa pratensis (Salgey/Poapra) comunity, the Salix geyeriana/Carex rostrata community (Salgey/Carros), and the unclassified Salix geyeriana stand (Uncl). Relative canopy cover for species A in a plot = (cover of species A in the plot/cover of all species in the plot).

	Plots							
	Salgey/Poapra						Salgey/Carros	Uncl
	5	7	7	6	7	6	3	2
	3	3	2	1	4	3	3	3
SPECIES	1	1	1	1	1	1	3	1
TREES								
Abies lasiocarpa								
Picea engelmannii								
Picea pungens								
Pinus contorta					30 (17)			
Populus angustifolia								
Populus tremuloides					1 (1)			10 (6)
TALL SHRUBS AND SAPLINGS								
Alnus incana					3 (2)	3 (2)		30 (19)
Amelanchier alnifolia								
Betula occidentalis		3 (2)	3 (2)					
Populus angustifolia sapling								
Populus tremuloides sapling								
Salix bebbiana								
Salix boothii	10 (9)	20 (11)			10 (6)			
Salix exigua								
Salix geyeriana	30 (28)	40 (22)	40 (23)	20 (11)	20 (11)	10 (7)	40 (34)	50 (31)
Salix lasiandra			3 (2)	40 (22)		10 (7)		
Salix spp.								
MEDIUM SHRUBS								
Artemisia cana								
Artemisia tridentata								3 (2)
Chrysothamnus nauseosus								
Chrysothamnus parryi								
Cornus sericea								
Juniperus communis			1 (1)	1 (1)	20 (11)			10 (6)
Lonicera involucrata		10 (5)	1 (1)	1 (1)	10 (6)	1 (1)		1 (1)
Potentilla fruticosa	1 (1)	1 (1)	3 (2)	3 (2)	10 (6)			
Ribes inerme				10 (6)				
Ribes oxyacanthoides	1 (1)							

	Plots							
			Salgey/ Poapra				Salgey/ Carros	Uncl
	5	7	7	6	7	6	3	2
	3	3	2	1	4	3	3	3
SPECIES	1	1	1	1	1	1	3	1
Ribes sp.		10 (5)	3 (2)		1 (1)			
Rosa woodsii					10 (6)			3 (2)
Rubus idaeus		10 (5)				1 (1)		
Salix planifolia								
Salix wolfii				10 (6)			10 (9)	
Shepherdia canadensis					1 (1)			
Symphoricarpos occidentalis								
Symphoricarpos oreophilus								
LOW SHRUBS AND SEEDLINGS								
Arctostaphylos uva-ursi					3 (2)			
Mahonia repens								1 (1)
Picea engelmanii seedling								1 (1)
Populus angustifolia seedling								
Vaccinium scoparium								
GRAMINOIDS								
Agropyron spp.		3 (2)						
Agropyron subsecundum								
Agropyron trachycaulum			3 (2)					
Agrostis exarata								3 (2)
Agrostis scabra								3 (2)
Bromus anomalus		3 (2)			10 (6)	3 (2)		
Bromus ciliatus	1 (1)		3 (2)				1 (1)	
Bromus sp.								3 (2)
Calamagrostis canadensis	1 (1)				3 (2)		10 (9)	
Carex aquatilis						3 (2)		
Carex aurea						1 (1)		
Carex athrostachya								
Carex gynocrates								
Carex lanuginosa								
Carex microptera		1 (1)		10 (6)	10 (6)	1 (1)	10 (9)	
Carex pensylvanica								3 (2)
Carex rostrata				10 (6)		3 (2)	30 (26)	
Carex spp.	30 (28)		3 (2)					
Danthonia intermedia								

	Plots							
			Salgey/ Poapra				Salgey/ Carros	Uncl
	5 3 1	7 3 1	7 2 1	6 1 1	7 4 1	6 3 1	3 3 3	2 3 1
SPECIES								
Deschampsia caespitosa	1 (1)	1 (1)	3 (2)					
Eleocharis palustris								
Elymus glaucus								
Elymus x macounii								
Elymus sp.								
Festuca idahoensis								
Festuca saximontana						3 (2)		
Glyceria striata			3 (2)	3 (2)	3 (2)	20 (14)		
Hordeum brachyantherum								
Juncus balticus		1 (1)		3 (2)		3 (2)		
Juncus halleyi & J. traceyi								
Juncus longistylus & J. ensifolius								1 (1)
Juncus mertensianus								
Juncus sp.						3 (2)		
Koeleria macrantha						1 (1)		
Muhlenbergia richardsonis								
Phleum alpinum								
Phleum pratense*	3 (3)	3 (2)	3 92)	1 (1)		10 (7)		
Phleum sp.								
Poa interior								
Poa juncifolia								
Poa palustris*								
Poa pratensis*	3 (3)	20 (11)		20 (11)		10 (7)		
Poa sp.			3 (2)					3 (2)
Stipa lettermanii								
Stipa nelsonii								
Trisetum spicatum								
Trisetum wolfii								
FORBS								
Achillea millefolium	1 (1)	3 (2)	1 (1)	3 (2)		1 (1)	1 (1)	3 (2)
Aconitum columbianum				1 (1)				
Actaea rubra								
Agoseris glauca				1 (1)				
Allium spp.								
Anaphalis margaritacea								3 (2)

	Plots							
			Salgey/ Poapra				Salgey/ Carros	Uncl
	5	7	7	6	7	6	3	2
	3	3	2	1	4	3	3	3
SPECIES	1	1	1	1	1	1	3	1
Androsace filiformis								
Androsace septentrionalis								
Antennaria microphylla		3 (2)	3 (2)	1 (1)				1 (1)
Antennaria umbrinella								
Arnica chamissonis								
Arnica mollis	1 (1)							
Artemisia ludoviciana								
Aster adscendens					3 (2)			10 (6)
Aster foliaceus						3 (2)		
Aster occidentalis							3 (3)	
Astragalus alpinus								
Caltha leptosepala								
Campanula rotundifolia					1 (1)			1 (1)
Caradmine breweri								
Cerastium arvense					1 (1)		1 (1)	
Cerastium fontanum			1					
Cerastium nutans				1 (1)		1 (1)		
Cirsium arvense*							1 (1)	
Cirsium spp.		1 (1)	1 (1)	1 (1)		3 (2)	1 (1)	
Cirsium vulgare*								
Conioselinum scopulorum	1 (1)	3 (2)	3 (2)			3 (2)		
Descurainia incana							1 (1)	
Dodecatheon pulchellum			3 (2)			1 (1)		
Epilobium angustifolium		1 (1)			3 (2)			1 (1)
Epilobium brachycarpum								
Epilobium ciliatum						3 (2)	1 (1)	
Equisetum arvense								
Equisetum laevigatum			1 (1)	3 (2)	3 (2)	3 (2)		
Equisetum sp.								
Erigeron glabellus								
Erigeron speciosus				10 (6)				
Erigeron ursinus								
Fragaria virginiana								
Frasera speciosa	3 (3)	10 (5)	3 (2)	3 (2)	3 (2)	3 (2)	1 (1)	
Galium aparine				1 (1)		1 (1)		
Galium boreale		1 (1)			1 (1)			
Galium trifidum							1 (1)	

	Plots							
	Salgey/ Poapra						Salgey/ Carros	Uncl
	5 3 1	7 3 1	7 2 1	6 1 1	7 4 1	6 3 1	3 3 3	2 3 1
SPECIES								
Geranium richardsonii					3 (2)	3 (2)	1 (1)	1 (1)
Geum aleppicum	1 (1)	10 (5)	3 (2)	3 (2)	1 (1)	3 (2)		
Geum macrophyllum							1 (1)	
Heracleum sphondylium					3 (2)			
Hypericum formosum								
Ligusticum porteri								
Ligusticum tenuifolium				1 (1)				
Lupinus argenteus								
Maianthemum stellatum		1 (1)			1 (1)			
Medicago lupulina*								
Mentha arvensis		1 (1)			1 (1)			
Mertensia ciliata & M. arizonica					3 (2)			
Mitella pentandra								
Orthilia secunda								
Osmorhiza spp.								1 (1)
Oxypolis fendleri								
Pedicularis groenlandica	3 (3)		3 (2)	3 (2)		3 (2)	1 (1)	
Perideridia montana								
Plantago major*								
Polygonum bistortoides	3 (3)			1 (1)				
Polygonum douglasii							1 (1)	
Polygonum viviparum								
Potentilla anserina								
Potentilla diversifolia								
Potentilla gracilis	1 (1)			1 (1)	1 (1)			
Prunella vulgaris	1 (1)	1 (1)	3 (2)	1 (1)		10 (7)		1 (1)
Ranunculus spp.								
Rudbeckia laciniata								
Rumex crispus*								
Saxifraga odontoloma								
Senecio eremophilus								
Senecio triangularis								
Sidalcea neomexicana				3 (2)	3 (2)			
Solidago canadensis					3 (2)			10 (6)
Solidago gigantea								
Solidago multiradiata								
Stellaria borealis								

	Plots							
			Salgey/ Poapra				Salgey/ Carros	Uncl
	5	7	7	6	7	6	3	2
	3	3	2	1	4	3	3	3
SPECIES	1	1	1	1	1	1	3	1
Taraxacum officinale*	1 (1)	10 (5)	30 (17)	3 (2)	1 (1)	10 (7)	1 (1)	1 (1)
Thalictrum fendleri								
Thalictrum sparsiflorum	1 (1)	3 (2)	3 (2)	3 (2)				
Thalspi arvense*								
Tragopogon dubius*								
Trifolium longipes		10 (5)						
Trifolium pratense*	1 (1)		40 (23)	3 (2)		10 (7)		
Trifolium repens*								
Trollius laxus								
Urtica dioica		1 (1)						
Veronica wormskjoldii								
Veronica serpyllifolia								
Vicia americana					1 (1)			
Viola sp.								
Total tree cover					30			10
Total shrub cover	30	80	40	80	70	20	50	70
Tall	30	60	40	70	40	20	50	60
Medium	1	20	5	10	30	1		10
Low				3	3			1
Total graminoid cover	40	20	20	40	20	50	50	15
Total forb cover	15	50	80	30	30	40	10	30
Ground cover								
Bare soil	1	1	10	31	3	1	10	10
Gravel				1	1			3
Rock				1	1			10
Litter	80	80	60	40	40	80	70	50
Wood	3	3	3	3	3	3		10
Moss	3	1	10	30	30	1		

* Exotic species

Table I-5. Absolute canopy cover (and relative canopy cover) for each species in plots of the Salix boothii/Poa pratensis community (Salboo/Poapra) and in the unclassified Salix boothii stand (Uncl). Relative canopy cover for species A in a plot = (cover of species A in the plot/cover of all species in the plot).

	Plots			
		Salboo/ Poapra		Uncl
	1	1	4	3
	3	8	2	3
SPECIES	3	1	1	1
TREES				
Abies lasiocarpa				
Picea engelmannii				
Picea pungens				
Pinus contorta				
Populus angustifolia				
Populus tremuloides				
TALL SHRUBS AND SAPLINGS				
Alnus incana		3 (2)		
Amelanchier alnifolia	1 (0.4)			
Betula occidentalis				
Populus angustifolia sapling				
Populus tremuloides sapling				
Salix bebbiana				
Salix boothii	80 (36)	70 (41)	60 (30)	90 (46)
Salix exigua	10 (4)			
Salix geyeriana				
Salix lasiandra				
Salix spp.		1 (1)		3 (2)
MEDIUM SHRUBS				
Artemisia cana				
Artemisia tridentata				
Chrysothamnus nauseosus				
Chrysothamnus parryi				
Cornus sericea				
Juniperus communis				
Lonicera involucrata	20 (9)			
Potentilla fruticosa	1 (0.4)			
Ribes inerme		1 (1)	20 (10)	
Ribes oxyacanthoides				
Ribes sp.				
Rosa woodsii		1 (1)	1 (0.4)	
Rubus idaeus	1 (0.4)			
Salix planifolia				
Salix wolfii				
Shepherdia canadensis				
Symphoricarpos occidentalis			1 (0.4)	
Symphoricarpos oreophilus				
LOW SHRUBS AND SEEDLINGS				
Arctostaphylos uva-ursi				
Mahonia repens				
Picea engelmanii seedling				
Populus angustifolia seedling				
Vaccinium scoparium				
GRAMINOIDS				
Agropyron spp.				

SPECIES	Plots 1 3 3	Salboo/ Poapra 1 8 1	4 2 1	Uncl 3 3 1
Agropyron subsecundum			1 (0.4)	
Agropyron trachycaulum	1 (0.4)	10 (6)		
Agrostis exarata		1 (1)	3 (1)	
Agrostis scabra				6 (3)
Bromus anomalus	10 (4)		10 (5)	
Bromus ciliatus				
Bromus sp.				
Calamagrostis canadensis				
Carex aquatilis				
Carex aurea				
Carex athrostachya				
Carex gynocrates	10 (4)			
Carex lanuginosa				
Carex microptera	3 (1)		3 (1)	40 (20)
Carex pensylvanica				
Carex rostrata				
Carex spp.	1 (0.4)		1 (0.4)	
Danthonia intermedia				
Deschampsia caespitosa				3 (2)
Eleocharis palustris	1 (0.4)			
Elymus glaucus				
Elymus x macounii			3 (1)	
Elymus sp.				
Festuca idahoensis				
Festuca saximontana				
Glyceria striata		20 (12)		
Hordeum brachyantherum				
Juncus balticus	3 (1)			
Juncus halleyi & J. traceyi				
Juncus longistylus & J. ensifolius				
Juncus mertensianus				
Juncus sp.				
Koeleria macrantha				
Muhlenbergia richardsonis				
Phleum alpinum				
Phleum pratense*		10 (6)		1 (1)
Phleum sp.				
Poa interior				
Poa juncifolia				
Poa palustris*	10 (4)			
Poa pratensis*	20 (9)	3 (2)	20 (10)	
Poa sp.				
Stipa lettermanii				
Stipa nelsonii				
Trisetum spicatum				
Trisetum wolfii				
FORBS				
Achillea millefolium	1 (0.4)	3 (2)	10 (5)	
Aconitum columbianum			1 (0.4)	
Actaea rubra				
Agoseris glauca				
Allium spp.				
Anaphalis margaritacea				
Androsace filiformis				

SPECIES	Plots 1 3 3	Salboo/ Poapra 1 8 1	4 2 1	Uncl 3 3 1
Androsace septentrionalis				
Antennaria microphylla				
Antennaria umbrinella				
Arnica chamissonis			1 (0.4)	
Arnica mollis				
Artemisia ludoviciana				
Aster adscendens				
Aster foliaceus			10 (5)	3 (2)
Aster occidentalis				
Astragalus alpinus				
Caltha leptosepala				
Campanula rotundifolia				
Caradmine breweri				
Cerastium arvense				
Cerastium fontanum				
Cerastium nutans				
Cirsium arvense*		20 (12)	10 (5)	
Cirsium spp.				
Cirsium vulgare*			1 (0.4)	
Conioselinum scopulorum				
Descurainia incana				
Dodecatheon pulchellum				
Epilobium angustifolium				
Epilobium brachycarpum				
Epilobium ciliatum		1 (1)		3 (2)
Equisetum arvense	3 (1)			
Equisetum laevigatum	1 (0.4)			
Equisetum sp.				
Erigeron glabellus				
Erigeron speciosus				
Erigeron ursinus				
Fragaria virginiana				
Frasera speciosa	10 (4)		3 (1)	3 (2)
Galium aparine				
Galium boreale	3 (1)			
Galium trifidum				30 (15)
Geranium richardsonii	3 (1)	1 (1)	1 (0.4)	
Geum aleppicum	1 (0.4)		3 (1)	
Geum macrophyllum				10 (5)
Heracleum sphondylium				
Hypericum formosum				
Ligusticum porteri				
Ligusticum tenuifolium				1 (1)
Lupinus argenteus				
Maianthemum stellatum	10 (4)	1 (1)		
Medicago lupulina*				
Mentha arvensis				
Mertensia ciliata & M. arizonica	3 (1)	3 (2)		
Mitella pentandra				
Orthilia secunda				
Osmorhiza spp.				
Oxypolis fendleri				
Pedicularis groenlandica				
Perideridia montana				
Plantago major*				

SPECIES	Plots: 1 / 3 / 3	Salboo/Poapra: 1 / 8 / 1	4 / 2 / 1	Uncl: 3 / 3 / 1
Polygonum bistortoides				
Polygonum douglasii			1 (0.4)	
Polygonum viviparum				
Potentilla anserina			1 (0.4)	
Potentilla diversifolia				
Potentilla gracilis	1 (0.4)		1 (0.4)	
Prunella vulgaris				
Ranunculus spp.				
Rudbeckia laciniata		3 (2)		
Rumex crispus*				
Saxifraga odontoloma				
Senecio eremophilus				
Senecio triangularis				
Sidalcea neomexicana	1 (0.4)			
Solidago canadensis				
Solidago gigantea		3 (2)		
Solidago multiradiata				
Stellaria borealis				
Taraxacum officinale*	3 (1)	10 (6)	20 (10)	
Thalictrum fendleri	10 (4)		3 (1)	
Thalictrum sparsiflorum				
Thalspi arvense*				
Tragopogon dubius*				
Trifolium longipes				
Trifolium pratense*			10 (5)	
Trifolium repens*	1 (0.4)	3 (2)		
Trollius laxus				
Urtica dioica			3 (1)	
Veronica wormskjoldii				
Veronica serpyllifolia				1 (1)
Vicia americana	3 (1)	3 (2)		
Viola sp.				1 (1)
Total tree cover				
Total shrub cover	80	74	60	90
Tall	80	74	50	90
Medium	2	1	20	
Low				
Total graminoid cover	40	40	20	40
Total forb cover	40	40	40	40
Ground cover				
Bare soil	1	10	3	1
Gravel				
Rock	1			
Litter	80	75	90	85
Wood	1	1	3	
Moss	1			10

* Exotic species

Table I-6. Absolute canopy cover (and relative canopy cover) for each species in plots of the Alnus incana/Mesic Graminoid community (Alninc/MG) and the unclassified Alnus incana stand (Uncl). Relative canopy cover for species A in a plot = (cover of species A in the plot/cover of all species in the plot).

	Plots Alninc/MG				Uncl
	4	1	1	8	9
	1	3	6	2	1
SPECIES	1	1	2	1	1
TREES					
Abies lasiocarpa					20 (13)
Picea engelmannii					20 (13)
Picea pungens					
Pinus contorta					
Populus angustifolia					
Populus tremuloides					
TALL SHRUBS AND SAPLINGS					
Alnus incana	90 (42)	73 (29)	50 (16)	30 (18)	60 (38)
Amelanchier alnifolia					
Betula occidentalis					
Cornus sericea		3 (1)			
Lonicera involucrata		3 (1)		1 (1)	1 (1)
Populus angustifolia sapling		3 (1)		3 (2)	
Populus tremuloides sapling					
Salix bebbiana					
Salix boothii		4 (2)	30 (9)	3 (2)	
Salix exigua		3 (1)		10 (6)	
Salix geyeriana					10 (6)
Salix lasiandra		3 (1)			
Salix planifolia					
Salix spp.					
MEDIUM SHRUBS					
Artemisia cana					
Artemisia tridentata					
Chrysothamnus nauseosus				3 (2)	
Chrysothamnus parryi				10 (6)	
Juniperus communis	3 (1)				
Potentilla fruticosa					
Ribes inerme					
Ribes oxyacanthoides					3 (2)
Ribes sp.				3 (2)	
Rosa woodsii					
Rubus idaeus					
Salix wolfii					
Shepherdia canadensis					
Symphoricarpos occidentalis					
Symphoricarpos oreophilus					
LOW SHRUBS AND SEEDLINGS					
Arctostaphylos uva-ursi					
Mahonia repens					
Picea engelmanii seedling					
Populus angustifolia seedling		3 (1)	50 (16)		
Vaccinium scoparium					10 (6)
GRAMINOIDS					
Agropyron spp.					
Agropyron subsecundum					

SPECIES	Plots Alninc/MG 4 1 1	1 3 1	1 6 2	8 2 1	Uncl 9 1 1
Agropyron trachycaulum				1 (1)	
Agrostis exarata	3 (1)			1 (1)	
Agrostis scabra		10 (4)			
Bromus anomalus					
Bromus ciliatus				1 (1)	
Bromus sp.					
Calamagrostis canadensis				50 (30)	3 (2)
Carex aquatilis	10 (5)				
Carex aurea					
Carex athrostachya					
Carex gynocrates					
Carex lanuginosa		1 (0.4)			
Carex microptera	1 (0.4)	3 (1)		10 (6)	
Carex pensylvanica					
Carex rostrata					
Carex spp.	3 (1)		10 (3)	3 (2)	1 (1)
Danthonia intermedia					
Deschampsia caespitosa					
Eleocharis palustris		10 (4)	20 (6)		
Elymus glaucus					
Elymus x macounii				3 (2)	
Elymus sp.					
Festuca idahoensis					
Festuca saximontana					
Glyceria striata	30 (14)		20 (6)	1 (1)	
Hordeum brachyantherum					
Juncus balticus	3 (1)	3 (1)	30 (9)		1 (1)
Juncus halleyi & J. traceyi					
Juncus longistylus & J. ensifolius		3 (1)	1 (0.4)		
Juncus mertensianus					1 (1)
Juncus sp.					
Koeleria macrantha					
Muhlenbergia richardsonis					
Phleum alpinum					
Phleum pratense*	3 (1)		3 (1)	1 (1)	
Phleum sp.				1 (1)	
Poa interior				3 (2)	
Poa juncifolia					
Poa palustris*				1 (1)	
Poa pratensis*	10 (5)	60 (24)	30 (9)		
Poa sp.					
Stipa lettermanii					
Stipa nelsonii					
Trisetum spicatum					1 (1)
Trisetum wolfii					
FORBS					
Achillea millefolium		1 (0.4)			
Aconitum columbianum					
Actaea rubra				3 (2)	
Agoseris glauca					
Allium spp.				1 (1)	
Anaphalis margaritacea					
Androsace filiformis				1 (1)	
Androsace septentrionalis					
Antennaria microphylla					1 (1)

SPECIES	Plots Alninc/MG 4 1 1	1 3 1	1 6 2	8 2 1	Uncl 9 1 1
Antennaria umbrinella					
Arnica chamissonis					
Arnica mollis					3 (2)
Artemisia ludoviciana					
Aster adscendens					
Aster foliaceus					
Aster occidentalis					
Astragalus alpinus					
Caltha leptosepala					
Campanula rotundifolia					
Caradmine breweri	3 (1)				
Cerastium arvense					
Cerastium fontanum					
Cerastium nutans					
Cirsium arvense*		10 (4)			
Cirsium spp.					
Cirsium vulgare*					
Conioselinum scopulorum				3 (2)	
Descurainia incana					
Dodecatheon pulchellum				1 (1)	
Epilobium angustifolium				2 (1)	3 (2)
Epilobium brachycarpum					
Epilobium ciliatum			10 (3)		
Equisetum arvense					
Equisetum laevigatum	3 (1)			1 (1)	1 (1)
Equisetum sp.				1 (1)	
Erigeron glabellus		10 (4)	10 (3)		
Erigeron speciosus					10 (6)
Erigeron ursinus				1 (1)	
Fragaria virginiana					
Frasera speciosa					
Galium aparine		3 (1)			
Galium boreale					
Galium trifidum				1 (1)	
Geranium richardsonii		1 (0.4)		1 (1)	1 (1)
Geum aleppicum		3 (1)	1 (0.4)	1 (1)	
Geum macrophyllum					
Heracleum sphondylium				3 (2)	
Hypericum formosum		3 (1)			
Ligusticum porteri					1 (1)
Ligusticum tenuifolium					
Lupinus argenteus					
Maianthemum stellatum	3 (1)	20 (8)		1 (1)	1 (1)
Medicago lupulina*					
Mentha arvensis	10 (5)		20 (6)	1 (1)	
Mertensia ciliata & M. arizonica	10 (5)				
Mitella pentandra					
Orthilia secunda					1 (1)
Osmorhiza spp.					1 (1)
Oxypolis fendleri					
Pedicularis groenlandica					1 (1)
Perideridia montana					
Plantago major*			1 (0.4)		
Polygonum bistortoides					
Polygonum douglasii					
Polygonum viviparum					

SPECIES	Plots Alninc/MG 4 1 1	1 3 1	1 6 2	8 2 1	Uncl 9 1 1
Potentilla anserina					
Potentilla diversifolia					
Potentilla gracilis	3 (1)				
Prunella vulgaris	10 (5)		20 (6)		
Ranunculus spp.					
Rudbeckia laciniata	10 (5)	3 (1)	1 (0.4)		
Rumex crispus*					
Saxifraga odontoloma					1 (1)
Senecio eremophilus		3 (1)			
Senecio triangularis				3 (2)	1 (1)
Sidalcea neomexicana					
Solidago canadensis					
Solidago gigantea					
Solidago multiradiata					
Stellaria borealis				1 (1)	
Taraxacum officinale*	3 (1)	3 (1)	1 (0.4)		
Thalictrum fendleri		3 (1)		1 (1)	
Thalictrum sparsiflorum					
Thalspi arvense*					
Tragopogon dubius*					
Trifolium longipes					
Trifolium pratense*	3 (1)				
Trifolium repens*					
Trollius laxus					
Urtica dioica		1 (0.4)			
Veronica wormskjoldii					
Veronica serpyllifolia					
Vicia americana	1 (0.4)			1 (1)	
Viola sp.		1 (0.4)			
Total tree cover					20
Total shrub cover	90	90	70	40	60
Tall	90	90	50	40	60
Medium	3			6	3
Low		3	50		10
Total graminoid cover	50	90	80	60	3
Total forb cover	40	40	50	20	20
Ground cover					
Bare soil	3	10	30	1	1
Gravel	1			1	10
Rock	1	1	1	1	40
Litter	75	80	60	70	30
Wood	10	1	1	30	10
Moss	3		3	1	3

* Exotic species

Table I-7. Absolute canopy cover (and relative canopy cover) for each species in plots of the Salix wolfii/Deschampsia caespitosa community. Relative canopy cover for species A in a plot = (cover of species A in the plot/cover of all species in the plot).

Species	Plots 01 1	01 2
TREES		
Abies lasiocarpa		
Picea engelmannii		
Picea pungens		
Pinus contorta		1 (1)
Populus angustifolia		
Populus tremuloides		
TALL SHRUBS AND SAPLINGS		
Alnus incana		
Amelanchier alnifolia		
Betula occidentalis		
Populus angustifolia sapling		
Populus tremuloides sapling		
Salix bebbiana		
Salix boothii		
Salix exigua		
Salix geyeriana		
Salix lasiandra		
Salix spp.		
MEDIUM SHRUBS		
Artemisia cana		
Artemisia tridentata		
Chrysothamnus nauseosus		
Chrysothamnus parryi		
Cornus sericea		
Juniperus communis		
Lonicera involucrata		
Potentilla fruticosa	10 (7)	3 (2)
Ribes inerme		
Ribes oxyacanthoides		
Ribes sp.		
Rosa woodsii		
Rubus idaeus		
Salix planifolia	1 (1)	3 (2)
Salix wolfii	70 (51)	80 (57)
Shepherdia canadensis		
Symphoricarpos occidentalis		
Symphoricarpos oreophilus		
LOW SHRUBS AND SEEDLINGS		
Arctostaphylos uva-ursi		
Mahonia repens		
Picea engelmanii seedling	1 (1)	
Populus angustifolia seedling		
Vaccinium scoparium		
GRAMINOIDS		
Agropyron spp.		
Agropyron subsecundum		
Agropyron trachycaulum		

Species	Plots 0 1 1	0 1 2
Agrostis exarata		
Agrostis scabra		
Bromus anomalus		
Bromus ciliatus		
Bromus sp.		
Calamagrostis canadensis		
Carex aquatilis		
Carex aurea		
Carex athrostachya		
Carex gynocrates		
Carex lanuginosa		
Carex microptera	10 (7)	20 (14)
Carex pensylvanica		
Carex rostrata		
Carex spp.		
Danthonia intermedia	1 (1)	1 (1)
Deschampsia caespitosa	3 (2)	3 (2)
Eleocharis palustris		
Elymus glaucus		
Elymus x macounii		
Elymus sp.		
Festuca idahoensis		
Festuca saximontana	1 (1)	
Glyceria striata		
Hordeum brachyantherum		
Juncus balticus	1 (1)	
Juncus halleyi & J. traceyi		
Juncus longistylus & J. ensifolius		
Juncus mertensianus		
Juncus sp.		
Koeleria macrantha		
Muhlenbergia richardsonis		
Phleum alpinum	3 (2)	1 (1)
Phleum pratense*		
Phleum sp.		
Poa interior		
Poa juncifolia		
Poa palustris*		
Poa pratensis*		
Poa sp.	1 (1)	
Stipa lettermanii		
Stipa nelsonii		
Trisetum spicatum	1 (1)	1 (1)
Trisetum wolfii	1 (1)	
FORBS		
Achillea millefolium	3 (2)	3 (2)
Aconitum columbianum		
Actaea rubra		
Agoseris glauca	3 (2)	1 (1)
Allium spp.		
Anaphalis margaritacea		
Androsace filiformis		
Androsace septentrionalis		
Antennaria microphylla		
Antennaria umbrinella	1 (1)	3 (2)
Arnica chamissonis		

Species	Plots 0 1 1	0 1 2
Arnica mollis		
Artemisia ludoviciana		
Aster adscendens		
Aster foliaceus		
Aster occidentalis		
Astragalus alpinus		
Caltha leptosepala		
Campanula rotundifolia		
Caradmine breweri		
Cerastium arvense		
Cerastium fontanum		
Cerastium nutans		
Cirsium arvense*		
Cirsium spp.		
Cirsium vulgare*		
Conioselinum scopulorum		
Descurainia incana		
Dodecatheon pulchellum		
Epilobium angustifolium		
Epilobium brachycarpum		
Epilobium ciliatum		
Equisetum arvense		
Equisetum laevigatum		
Equisetum sp.		
Erigeron glabellus		
Erigeron speciosus		
Erigeron ursinus		
Fragaria virginiana	10 (7)	3 (2)
Frasera speciosa		
Galium aparine		
Galium boreale		
Galium trifidum		
Geranium richardsonii		
Geum aleppicum		
Geum macrophyllum		
Heracleum sphondylium		
Hypericum formosum		
Ligusticum porteri		
Ligusticum tenuifolium		
Lupinus argenteus		
Maianthemum stellatum		
Medicago lupulina*		
Mentha arvensis		
Mertensia ciliata & M. arizonica		
Mitella pentandra		
Orthilia secunda		
Osmorhiza spp.		
Oxypolis fendleri	1 (1)	
Pedicularis groenlandica	1 (1)	1 (1)
Perideridia montana		
Plantago major*		
Polygonum bistortoides		
Polygonum douglasii		
Polygonum viviparum		
Potentilla anserina		
Potentilla diversifolia	1 (1)	3 (2)
Potentilla gracilis		

Species	Plots 0 1 1	0 1 2
Prunella vulgaris		
Ranunculus spp.		
Rudbeckia laciniata		
Rumex crispus*		
Saxifraga odontoloma		
Senecio eremophilus		
Senecio triangularis		
Sidalcea neomexicana		
Solidago canadensis		
Solidago gigantea		
Solidago multiradiata	1 (1)	4 (3)
Stellaria borealis	1 (1)	1 (1)
Taraxacum officinale*	3 (2)	3 (2)
Thalictrum fendleri		
Thalictrum sparsiflorum		
Thalspi arvense*		
Tragopogon dubius*		
Trifolium longipes		
Trifolium pratense*		
Trifolium repens*		
Trollius laxus	3 (2)	1 (1)
Urtica dioica		
Veronica wormskjoldii	1 (1)	3 (2)
Veronica serpyllifolia	1 (1)	1 (1)
Vicia americana		
Viola sp.		
Total tree cover		1
Total shrub cover	70	80
Tall	70	80
Medium	10	3
Low	1	
Total graminoid cover	20	20
Total forb cover	30	20
Ground cover		
Bare soil	3	1
Gravel	1	
Rock	3	1
Litter	90	90
Wood		
Moss	1	3

* Exotic species

Table I-8. Absolute canopy cover (and relative canopy cover) for each species in plots of the Artemisia cana/Poa pratensis community. Relative canopy cover for species A in a plot = (cover of species A in the plot/cover of all species in the plot).

SPECIES	Plots 12 2	16 1	41 2	61 2
TREES				
Abies lasiocarpa				
Picea engelmannii				
Picea pungens				
Pinus contorta				
Populus angustifolia				
Populus tremuloides				
TALL SHRUBS AND SAPLINGS				
Alnus incana				
Amelanchier alnifolia				
Betula occidentalis				
Populus angustifolia sapling				
Populus tremuloides sapling				
Salix bebbiana				
Salix boothii				
Salix exigua				
Salix geyeriana				
Salix lasiandra				
Salix spp.				
MEDIUM SHRUBS				
Artemisia cana	40 (28)	60 (39)	10 (10)	70 (47)
Artemisia tridentata	10 (7)	1 (1)		
Chrysothamnus nauseosus				
Chrysothamnus parryi		1 (1)		
Cornus sericea				
Juniperus communis				
Lonicera involucrata				
Potentilla fruticosa	3 (2)	3 (2)		1 (1)
Ribes inerme		3 (2)		
Ribes oxyacanthoides				
Ribes sp.				
Rosa woodsii		3 (2)		
Rubus idaeus				
Salix planifolia				
Salix wolfii				
Shepherdia canadensis				
Symphoricarpos occidentalis			10 (10)	
Symphoricarpos oreophilus		1 (1)		
LOW SHRUBS AND SEEDLINGS				
Arctostaphylos uva-ursi				
Mahonia repens			1 (1)	
Picea engelmanii seedling				
Populus angustifolia seedling				
Vaccinium scoparium				
GRAMINOIDS				
Agropyron spp.				
Agropyron subsecundum		1 (1)	3 (3)	
Agropyron trachycaulum	3 (2)			1 (1)

SPECIES	Plots 1 2 2	1 6 1	4 1 2	6 1 2
Agrostis exarata	1 (1)		10 (10)	
Agrostis scabra	1 (1)			
Bromus anomalus	10 (7)	3 (2)	10 (10)	
Bromus ciliatus	3 (2)			
Bromus sp.				
Calamagrostis canadensis				
Carex aquatilis				
Carex aurea				
Carex athrostachya				
Carex gynocrates				
Carex lanuginosa				
Carex microptera				
Carex pensylvanica				
Carex rostrata				
Carex spp.	3 (2)	3 (2)		
Danthonia intermedia				
Deschampsia caespitosa				
Eleocharis palustris				
Elymus glaucus				
Elymus x macounii				
Elymus sp.				
Festuca idahoensis	3 (2)			
Festuca saximontana				
Glyceria striata				
Hordeum brachyantherum			1 (1)	
Juncus balticus		3 (2)		1 (1)
Juncus halleyi & J. traceyi				
Juncus longistylus & J. ensifolius				
Juncus mertensianus				
Juncus sp.				
Koeleria macrantha	1 (1)			
Muhlenbergia richardsonis	1 (1)	1 (1)		
Phleum alpinum				
Phleum pratense*	1 (1)	1 (1)	1 (1)	10 (7)
Phleum sp.				
Poa interior				
Poa juncifolia				
Poa palustris*	1 (1)			
Poa pratensis*	10 (7)	20 (13)	20 (19)	20 (13)
Poa sp.				
Stipa lettermanii	10 (7)	20 (13)	3 (3)	
Stipa nelsonii	4 (3)	1 (1)		
Trisetum spicatum				
Trisetum wolfii				
FORBS				
Achillea millefolium	10 (7)	10 (6)	3 (3)	10 (7)
Aconitum columbianum				
Actaea rubra				
Agoseris glauca				
Allium spp.				
Anaphalis margaritacea				
Androsace filiformis				1 (1)
Androsace septentrionalis	1 (1)	1 (1)	1 (1)	
Antennaria microphylla				
Antennaria umbrinella				
Arnica chamissonis				

SPECIES	Plots 1 2 2	1 6 1	4 1 2	6 1 2
Arnica mollis				1 (1)
Artemisia ludoviciana				
Aster adscendens				
Aster foliaceus				1 (1)
Aster occidentalis				
Astragalus alpinus				
Caltha leptosepala				
Campanula rotundifolia				
Caradmine breweri				1 (1)
Cerastium arvense				
Cerastium fontanum				
Cerastium nutans				
Cirsium arvense*	1 (1)	1 (1)		
Cirsium spp.			3 (3)	1 (1)
Cirsium vulgare*				
Conioselinum scopulorum				
Descurainia incana				
Dodecatheon pulchellum				
Epilobium angustifolium				
Epilobium brachycarpum				
Epilobium ciliatum				
Equisetum arvense	3 (2)			
Equisetum laevigatum	1 (1)			
Equisetum sp.				
Erigeron glabellus	11 (8)			
Erigeron speciosus		10 (6)		
Erigeron ursinus				3 (2)
Fragaria virginiana				
Frasera speciosa				1 (1)
Galium aparine	1 (1)		1 (1)	
Galium boreale				
Galium trifidum				
Geranium richardsonii				
Geum aleppicum				1 (1)
Geum macrophyllum				
Heracleum sphondylium				
Hypericum formosum				
Ligusticum porteri				
Ligusticum tenuifolium				
Lupinus argenteus				
Maianthemum stellatum		1 (1)		
Medicago lupulina*				
Mentha arvensis				
Mertensia ciliata & M. arizonica				
Mitella pentandra				
Orthilia secunda				
Osmorhiza spp.				
Oxypolis fendleri				
Pedicularis groenlandica				
Perideridia montana			1 (1)	
Plantago major*				
Polygonum bistortoides				
Polygonum douglasii	1 (1)	1 (1)	3 (3)	1 (1)
Polygonum viviparum				
Potentilla anserina				
Potentilla diversifolia				
Potentilla gracilis	4 (3)	3 (2)	3 (3)	1 (1)

SPECIES	Plots 1 2 2	1 6 1	4 1 2	6 1 2
Prunella vulgaris				
Ranunculus spp.				
Rudbeckia laciniata				
Rumex crispus*		1 (1)		
Saxifraga odontoloma				
Senecio eremophilus				
Senecio triangularis				
Sidalcea neomexicana	1 (1)	1 (1)		
Solidago canadensis				
Solidago gigantea				
Solidago multiradiata				
Stellaria borealis				
Taraxacum officinale*	3 (2)	1 (1)	10 (10)	20 (13)
Thalictrum fendleri	1 (1)			
Thalictrum sparsiflorum				
Thalspi arvense*				
Tragopogon dubius*			1 (1)	
Trifolium longipes				
Trifolium pratense*			10 (10)	3 (2)
Trifolium repens*				
Trollius laxus				
Urtica dioica				
Veronica wormskjoldii				
Veronica serpyllifolia				
Vicia americana	1 (1)			1 (1)
Viola sp.				1 (1)
Total tree cover				
Total shrub cover	50	70	20	70
Tall				
Medium	50	70	20	70
Low		1		
Total graminoid cover	50	40	40	30
Total forb cover	30	20	30	30
Ground cover				
Bare soil	60	40	40	30
Gravel	1	1		1
Rock	1	1	1	
Litter	35	50	35	70
Wood	10	5	10	3
Moss	1			

* Exotic species

Table I-9. Absolute canopy cover (and relative canopy cover) for each species in plots of the Carex rostrata community. Relative canopy cover for species A in a plot = (cover of species A in the plot/cover of all species in the plot).

	Plots			
	3	2	2	7
	2	1	1	1
SPECIES	1	1	2	1
TREES				
Abies lasiocarpa				
Picea engelmannii				
Picea pungens				
Pinus contorta				
Populus angustifolia				
Populus tremuloides				
TALL SHRUBS AND SAPLINGS				
Alnus incana				
Amelanchier alnifolia				
Betula occidentalis				
Populus angustifolia sapling				
Populus tremuloides sapling				
Salix bebbiana				
Salix boothii				
Salix exigua				
Salix geyeriana				10 (9)
Salix lasiandra				1 (1)
Salix spp.			3 (5)	
MEDIUM SHRUBS				
Artemisia cana				
Artemisia tridentata				
Chrysothamnus nauseosus				
Chrysothamnus parryi				
Cornus sericea				
Juniperus communis				
Lonicera involucrata				
Potentilla fruticosa				
Ribes inerme				
Ribes oxyacanthoides				
Ribes sp.				
Rosa woodsii				
Rubus idaeus				
Salix planifolia				
Salix wolfii				
Shepherdia canadensis				
Symphoricarpos occidentalis				
Symphoricarpos oreophilus				
LOW SHRUBS AND SEEDLINGS				
Arctostaphylos uva-ursi				
Mahonia repens				
Picea engelmanii seedling				
Populus angustifolia seedling				
Vaccinium scoparium				
GRAMINOIDS				
Agropyron spp.				1 (1)
Agropyron subsecundum				
Agropyron trachycaulum	3 (2)			

SPECIES	Plots 3 2 1	2 1 1	2 1 2	7 1 1
Agrostis exarata				
Agrostis scabra		3 (3)		
Bromus anomalus	10 (8)			
Bromus ciliatus				
Bromus sp.				
Calamagrostis canadensis	1 (1)	1 (1)		
Carex aquatilis				
Carex aurea				
Carex athrostachya				1 (1)
Carex gynocrates				
Carex lanuginosa				
Carex microptera	10 (8)			
Carex pensylvanica		10 (11)	3 (5)	
Carex rostrata	20 (16)	30 (32)	50 (81)	60 (53)
Carex spp.				
Danthonia intermedia				
Deschampsia caespitosa	3 (2)	20 (22)	1 (2)	1 (1)
Eleocharis palustris				
Elymus glaucus				
Elymus x macounii				
Elymus sp.				
Festuca idahoensis		3 (3)		
Festuca saximontana				
Glyceria striata		1 (1)		3 (3)
Hordeum brachyantherum	10 (8)	3 (3)		
Juncus balticus				
Juncus halleyi & J. traceyi		1 (1)		1 (1)
Juncus longistylus & J. ensifolius				
Juncus mertensianus				
Juncus sp.				
Koeleria macrantha				
Muhlenbergia richardsonis				
Phleum alpinum				
Phleum pratense*	10 (8)	10 (11)		1 (1)
Phleum sp.				
Poa interior				
Poa juncifolia				
Poa palustris*				3 (3)
Poa pratensis*				
Poa sp.				
Stipa lettermanii				
Stipa nelsonii				
Trisetum spicatum				
Trisetum wolfii		3 (3)		
FORBS				
Achillea millefolium	10 (8)			1 (1)
Aconitum columbianum				
Actaea rubra				
Agoseris glauca				
Allium spp.				
Anaphalis margaritacea				
Androsace filiformis	1 (1)			
Androsace septentrionalis				
Antennaria microphylla				
Antennaria umbrinella				

SPECIES	Plots 3 2 1	2 1 1	2 1 2	7 1 1
Arnica chamissonis				
Arnica mollis				
Artemisia ludoviciana				
Aster adscendens				1 (1)
Aster foliaceus				
Aster occidentalis	10 (8)			
Astragalus alpinus				
Caltha leptosepala		3 (3)		
Campanula rotundifolia				
Caradmine breweri				
Cerastium arvense				
Cerastium fontanum				
Cerastium nutans				
Cirsium arvense*				
Cirsium spp.	1 (1)			1 (1)
Cirsium vulgare*				
Conioselinum scopulorum				1 (1)
Descurainia incana	1 (1)			
Dodecatheon pulchellum				
Epilobium angustifolium				1 (1)
Epilobium brachycarpum				
Epilobium ciliatum		1 (1)	1 (2)	
Equisetum arvense				
Equisetum laevigatum				
Equisetum sp.				
Erigeron glabellus				
Erigeron speciosus				
Erigeron ursinus				
Fragaria virginiana				
Frasera speciosa	10 (8)			
Galium aparine				
Galium boreale			3 (5)	
Galium trifidum	1 (1)			
Geranium richardsonii				
Geum aleppicum				3 (3)
Geum macrophyllum	10 (8)			
Heracleum sphondylium				
Hypericum formosum				
Ligusticum porteri				
Ligusticum tenuifolium				
Lupinus argenteus				
Maianthemum stellatum				
Medicago lupulina*				
Mentha arvensis				3 (3)
Mertensia ciliata & M. arizoni				
Mitella pentandra				
Orthilia secunda				
Osmorhiza spp.				
Oxypolis fendleri				
Pedicularis groenlandica				
Perideridia montana				
Plantago major*				
Polygonum bistortoides		3 (3)		
Polygonum douglasii	1 (1)			
Polygonum viviparum				1 (1)
Potentilla anserina				
Potentilla diversifolia				

SPECIES	Plots 3 2 1	2 1 1	2 1 2	7 1 1
Potentilla gracilis				1 (1)
Prunella vulgaris				3 (3)
Ranunculus spp.	1 (1)			1 (1)
Rudbeckia laciniata				
Rumex crispus*				1 (1)
Saxifraga odontoloma				
Senecio eremophilus				
Senecio triangularis				
Sidalcea neomexicana				1 (1)
Solidago canadensis				
Solidago gigantea				
Solidago multiradiata				
Stellaria borealis				
Taraxacum officinale*	10 (8)			10 (9)
Thalictrum fendleri				
Thalictrum sparsiflorum				
Thalspi arvense*				
Tragopogon dubius*				
Trifolium longipes				
Trifolium pratense*				3 (3)
Trifolium repens*				
Trollius laxus				
Urtica dioica				
Veronica wormskjoldii				
Veronica serpyllifolia		1 (1)	1 (2)	
Vicia americana				
Viola sp.				
Total tree cover				
Total shrub cover			3	10
Tall			3	10
Medium				
Low				
Total graminoid cover	70	70	50	70
Total forb cover	50	3	3	20
Ground cover				
Bare soil	3	10	80	1
Gravel	3			
Rock				
Litter	70	70	1	90
Wood		1		
Moss		3	10	

* Exotic species

Table I-10. Absolute canopy cover (and relative canopy cover) for each species in plots of the Juncus balticus community, the Carex microptera community, and the Carex aquatilis community. Relative canopy cover for species A in a plot = (cover of species A in the plot/cover of all species in the plot).

Species	Plots: Juncus balticus	Carex microptera	Carex aquatilis
	1	3	1
	9	3	2
	1	3	3
TREES			
Abies lasiocarpa			
Picea engelmannii			
Picea pungens			
Pinus contorta			
Populus angustifolia			
Populus tremuloides			
TALL SHRUBS AND SAPLINGS			
Alnus incana	1 (1)		
Amelanchier alnifolia			
Betula occidentalis			
Populus angustifolia sapling			
Populus tremuloides sapling			
Salix bebbiana			
Salix boothii			
Salix exigua			
Salix geyeriana			
Salix lasiandra			
Salix spp.			
MEDIUM SHRUBS			
Artemisia cana			
Artemisia tridentata			
Chrysothamnus nauseosus			
Chrysothamnus parryi			
Cornus sericea			
Juniperus communis			
Lonicera involucrata			
Potentilla fruticosa			
Ribes inerme	1 (1)		
Ribes oxyacanthoides			
Ribes sp.			
Rosa woodsii			
Rubus idaeus			
Salix planifolia			
Salix wolfii			
Shepherdia canadensis			
Symphoricarpos occidentalis			
Symphoricarpos oreophilus			
LOW SHRUBS AND SEEDLINGS			
Arctostaphylos uva-ursi			
Mahonia repens			
Picea engelmanii seedling			
Populus angustifolia seedling			
Vaccinium scoparium			

Species	Juncus balticus	Carex microptera	Carex aquatilis
Plots	1	3	1
	9	3	2
	1	3	3
GRAMINOIDS			
Agropyron spp.			
Agropyron subsecundum			
Agropyron trachycaulum			
Agrostis exarata	10 (7)		
Agrostis scabra			
Bromus anomalus			
Bromus ciliatus			
Bromus sp.			
Calamagrostis canadensis			
Carex aquatilis	1 (1)		50 (38)
Carex aurea			
Carex athrostachya			
Carex gynocrates			
Carex lanuginosa			
Carex microptera	3 (2)	30 (42)	
Carex pensylvanica			20 (15)
Carex rostrata		3 (4)	2
Carex spp.	10 (7)		
Danthonia intermedia			
Deschampsia caespitosa		30 (42)	3 (2)
Eleocharis palustris			
Elymus glaucus			
Elymus x macounii			
Elymus sp.			
Festuca idahoensis			
Festuca saximontana			
Glyceria striata	1 (1)		
Hordeum brachyantherum		3 (4)	
Juncus balticus	40 (27)		20 (15)
Juncus halleyi & J. traceyi	3 (2)		
Juncus longistylus & J. ensifolius			
Juncus mertensianus			
Juncus sp.			
Koeleria macrantha			
Muhlenbergia richardsonis			
Phleum alpinum			
Phleum pratense*	30 (20)		
Phleum sp.			
Poa interior			
Poa juncifolia			
Poa palustris*			1 (1)
Poa pratensis*	3 (2)		1 (1)
Poa sp.			
Stipa lettermanii			
Stipa nelsonii			
Trisetum spicatum			
Trisetum wolfii			
FORBS			
Achillea millefolium	3 (2)		
Aconitum columbianum			
Actaea rubra			
Agoseris glauca			

Species	Plots Juncus balticus 1 9 1	Carex microptera 3 3 3	Carex aquatilis 1 2 3
Allium spp.			
Anaphalis margaritacea			
Androsace filiformis			
Androsace septentrionalis			
Antennaria microphylla			
Antennaria umbrinella			
Arnica chamissonis	3 (2)		1 (1)
Arnica mollis			
Artemisia ludoviciana			
Aster adscendens			
Aster foliaceus			
Aster occidentalis		3 (4)	
Astragalus alpinus			
Caltha leptosepala			
Campanula rotundifolia			
Caradmine breweri			
Cerastium arvense			
Cerastium fontanum			
Cerastium nutans			
Cirsium arvense*			
Cirsium spp.			
Cirsium vulgare*			
Conioselinum scopulorum			
Descurainia incana			
Dodecatheon pulchellum			
Epilobium angustifolium			
Epilobium brachycarpum			
Epilobium ciliatum		1 (1)	1 (1)
Equisetum arvense			
Equisetum laevigatum			1 (1)
Equisetum sp.			
Erigeron glabellus	1 (1)		
Erigeron speciosus	1 (1)		
Erigeron ursinus			
Fragaria virginiana			
Frasera speciosa			
Galium aparine			
Galium boreale			
Galium trifidum		1 (1)	
Geranium richardsonii			
Geum aleppicum			
Geum macrophyllum			
Heracleum sphondylium			
Hypericum formosum	3 (2)		
Ligusticum porteri			
Ligusticum tenuifolium			
Lupinus argenteus			
Maianthemum stellatum			
Medicago lupulina*			
Mentha arvensis	1 (1)		10 (8)
Mertensia ciliata & M. arizonica			
Mitella pentandra			
Orthilia secunda			

Species	Plots: Juncus balticus	Carex microptera	Carex aquatilis
	1	3	1
	9	3	2
	1	3	3
Osmorhiza spp.			
Oxypolis fendleri			
Pedicularis groenlandica			
Perideridia montana	1 (1)		
Plantago major*			
Polygonum bistortoides			
Polygonum douglasii			
Polygonum viviparum			
Potentilla anserina			
Potentilla diversifolia			
Potentilla gracilis	3 (2)		1 (1)
Prunella vulgaris			
Ranunculus spp.			
Rudbeckia laciniata			
Rumex crispus*			
Saxifraga odontoloma			
Senecio eremophilus			
Senecio triangularis			
Sidalcea neomexicana	3 (2)		
Solidago canadensis			
Solidago gigantea			
Solidago multiradiata			
Stellaria borealis			
Taraxacum officinale*	20 (14)		
Thalictrum fendleri			
Thalictrum sparsiflorum			
Thalspi arvense*			
Tragopogon dubius*			
Trifolium longipes			
Trifolium pratense*			
Trifolium repens*	3 (2)		
Trollius laxus			
Urtica dioica			
Veronica wormskjoldii			
Veronica serpyllifolia			
Vicia americana	3 (2)		
Viola sp.			1 (1)
Total tree cover			
Total shrub cover	2		
Tall	1		
Medium			
Low			
Total graminoid cover	90	60	90
Total forb cover	30	5	15
Ground cover			
Bare soil	1	5	1
Gravel	1		
Rock	1		
Litter	95	90	80
Wood	1		
Moss			1

* Exotic species

Table I-11. Absolute canopy cover (and relative canopy cover) for each species in plots in the the unclassified stands. Relative canopy cover for species A in a plot = (cover of species A in the plot/cover of all species in the plot).

	Plots						
	4	8	8	3	6	6	1
	4	1	2	2	3	2	1
SPECIES	1	1	1	2	2	1	1
TREES							
Abies lasiocarpa							
Picea engelmannii							
Picea pungens							
Pinus contorta							
Populus angustifolia							
Populus tremuloides		20 (12)					
TALL SHRUBS AND SAPLINGS							
Alnus incana		10 (6)	30 (18)				
Amelanchier alnifolia		3 (2)					
Betula occidentalis		10 (6)					
Populus angustifolia sapling							
Populus tremuloides sapling		10 (6)	1 (1)				
Salix bebbiana			3 (2)				
Salix boothii							3 (2)
Salix exigua							
Salix geyeriana			3 (2)		3 (2)	1 (7)	
Salix lasiandra		20 (10)	10 (6)				
Salix spp.	3 (2)						
MEDIUM SHRUBS							
Artemisia cana					1 (1)		1 (1)
Artemisia tridentata					1 (1)		
Chrysothamnus nauseosus							
Chrysothamnus parryi							
Cornus sericea		3 (2)					
Juniperus communis		1 (1)	3 (2)				
Lonicera involucrata		1 (1)	10 (6)				
Potentilla fruticosa							
Ribes inerme						1 (7)	
Ribes oxyacanthoides		3 (2)					
Ribes sp.							
Rosa woodsii		3 (2)	3 (2)				
Rubus idaeus		3 (2)			1 (1)	3 (20)	
Salix planifolia							
Salix wolfii							
Shepherdia canadensis							
Symphoricarpos occidentalis							
Symphoricarpos oreophilus							
LOW SHRUBS AND SEEDLINGS							
Arctostaphylos uva-ursi							
Mahonia repens							
Picea engelmanii seedling							
Populus angustifolia seedling							
Vaccinium scoparium							
GRAMINOIDS	2						
Agropyron spp.	20 (15)	3 (2)					
Agropyron subsecundum							

SPECIES	Plots 4 4 1	8 1 1	8 2 1	3 2 2	6 3 2	6 2 1	1 1 1
Agropyron trachycaulum			1 (1)	1 (1)	10 (8)	1 (7)	
Agrostis exarata			1 (1)				
Agrostis scabra				1 (1)			3 (2)
Bromus anomalus				1 (1)	1 (1)		1 (1)
Bromus ciliatus			1 (1)				
Bromus sp.							
Calamagrostis canadensis		1 (1)	50 (30)				
Carex aquatilis	3 (2)						
Carex aurea							
Carex athrostachya				3 (4)			
Carex gynocrates							
Carex lanuginosa							10 (6)
Carex microptera	10 (8)		10 (6)		3 (2)		
Carex pensylvanica							
Carex rostrata	10 (8)				1 (1)		10 (6)
Carex spp.	20 (15)	10 (6)	3 (2)				
Danthonia intermedia							
Deschampsia caespitosa				1 (1)			
Elymus glaucus							
Elymus x macounii			3 (2)				
Elymus sp.		3 (2)					
Festuca idahoensis							
Festuca saximontana					3 (2)	1 (7)	
Glyceria striata		1 (1)	1 (1)		3 (2)		
Hordeum brachyantherum	1 (1)	1 (1)		1 (1)			
Juncus balticus	10 (8)				10 (8)		
Juncus halleyi & J. traceyi	1 (1)						
Juncus longistylus & J. ensifolius							10 (6)
Juncus mertensianus							
Juncus sp.							
Koeleria macrantha				1 (1)			
Muhlenbergia richardsonis						1 (7)	
Phleum alpinum							
Phleum pratense*	3 (2)	3 (2)	1 (1)	3 (4)	20 (16)		30 (18)
Phleum sp.	10 (8)		1 (1)				
Poa interior			3 (2)			1 (7)	
Poa juncifolia							
Poa palustris*			1 (1)				
Poa pratensis*	10 (8)	20 (12)		3 (4)	10 (8)		10 (6)
Poa sp.							
Stipa lettermanii						1 (7)	1 (1)
Stipa nelsonii							
Trisetum spicatum							
Trisetum wolfii							
FORBS							
Achillea millefolium	1 (1)	1 (1)		1 (1)	10 (8)		3 (2)
Aconitum columbianum							
Actaea rubra		1 (1)	3 (2)				
Agoseris glauca							
Allium spp.			1 (1)				
Anaphalis margaritacea							
Androsace filiformis			1 (1)	10 (13)			
Androsace septentrionalis							
Antennaria microphylla				1 (1)	3 (2)		
Antennaria umbrinella							
Arnica chamissonis							

SPECIES	Plots 4 4 1	8 1 1	8 2 1	3 2 2	6 3 2	6 2 1	1 1 1
Arnica mollis							
Artemisia ludoviciana							
Aster adscendens							
Aster foliaceus				1 (1)			
Aster occidentalis		3 (2)					
Astragalus alpinus							
Caltha leptosepala							
Campanula rotundifolia						1 (7)	
Caradmine breweri							
Cerastium arvense				3 (4)			
Cerastium fontanum							
Cerastium nutans							1 (1)
Cirsium arvense*		1 (1)		10 (13)	10 (8)		
Cirsium spp.				1 (1)	1 (1)		3 (2)
Cirsium vulgare*							
Conioselinum scopulorum		1 (1)	3 (2)				
Descurainia incana							
Dodecatheon pulchellum			1 (1)				
Epilobium angustifolium			2 (1)				
Epilobium brachycarpum	1 (1)						
Epilobium ciliatum							
Equisetum arvense							
Equisetum laevigatum		3 (2)	1 (1)				3 (2)
Equisetum sp.			1 (1)				
Erigeron glabellus							3 (2)
Erigeron speciosus				3	1 (1)		
Erigeron ursinus			1 (1)				
Fragaria virginiana							
Frasera speciosa				20 (26)	20 (16)		
Galium aparine	1 (1)				1 (1)		
Galium boreale							1 (1)
Galium trifidum			1 (1)				
Geranium richardsonii		1 (1)	1 (1)				
Geum aleppicum	1 (1)	3 (2)	1 (1)		3 (2)		3 (2)
Geum macrophyllum							
Heracleum sphondylium		1 (1)	3 (2)				1 (1)
Hypericum formosum							
Ligusticum porteri							
Ligusticum tenuifolium							
Lupinus argenteus							
Maianthemum stellatum	1 (1)	3 (2)	1 (1)		1 (1)		
Medicago lupulina*							
Mentha arvensis	1 (1)		1 (1)				
Mertensia ciliata & M. arizonica						1 (7)	
Mitella pentandra							
Orthilia secunda							
Osmorhiza spp.							
Oxypolis fendleri							
Pedicularis groenlandica							
Perideridia montana							
Plantago major*							
Polygonum bistortoides							
Polygonum douglasii				10 (13)	1 (1)	1 (7)	
Polygonum viviparum							
Potentilla anserina	3 (2)						
Potentilla diversifolia							
Potentilla gracilis				1 (1)	3 (2)		3 (2)

SPECIES	Plots 4 4 1	8 1 1	8 2 1	3 2 2	6 3 2	6 2 1	1 1 1
Prunella vulgaris					1 (1)		1 (1)
Ranunculus spp.							
Rudbeckia laciniata		10 (6)					
Rumex crispus*							
Saxifraga odontoloma							
Senecio triangularis							
Sidalcea neomexicana			3 (2)				10 (6)
Solidago canadensis							
Solidago gigantea							
Solidago multiradiata							
Stellaria borealis							
Taraxacum officinale*	10 (8)	10 (6)	1 (1)	3 (4)	3 (2)	1 (7)	30 (18)
Thalictrum fendleri							
Thalictrum sparsiflorum			1 (1)				
Thalspi arvense*							1 (1)
Tragopogon dubius*							1 (1)
Trifolium longipes							
Trifolium pratense*	10 (8)	1 (1)			3 (2)		
Trifolium repens*							3 (2)
Trollius laxus							
Urtica dioica						1 (7)	
Veronica wormskjoldii							
Veronica serpyllifolia							
Vicia americana		1					3 (2)
Viola sp.		3 (2)	1 (1)				

* Exotic species

Appendix II. Diagrams of tree size-class structure.

The acronyms used in the following diagrams refer to these species:

Abilas = Abies lasiocarpa (subalpine fir)
Piceng = Picea engelmannii (Engalmann spruce)
Picpun = Picea pungens (blue spruce)
Pincon = Pinus contorta (lodgepole pine)
Popang = Populus angustifolia (narrowleaf cottonwood)
Poptre = Populus tremuloides (aspen)

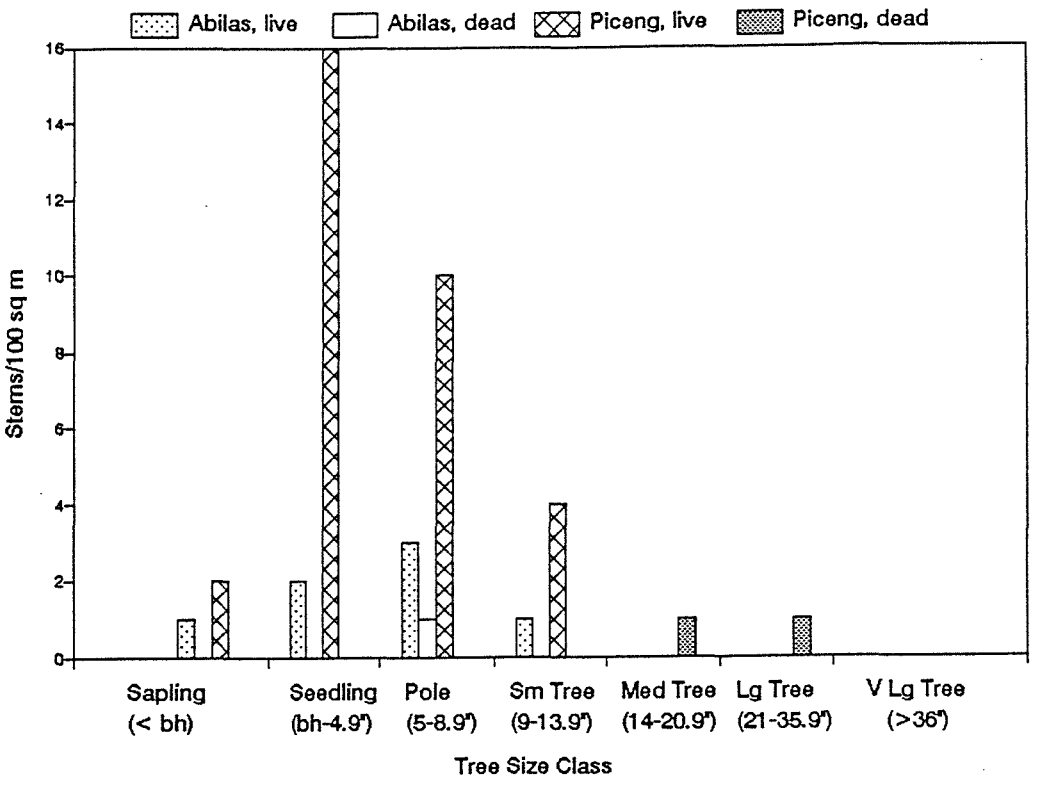

Figure II-1. Tree size class distribution in plot 213 (Picea engelmannii/Galium triflorum community).

Abilas = Abies lasiocarpa (subalpine fir)
Piceng = Picea engelmannii (Engelmann spruce)

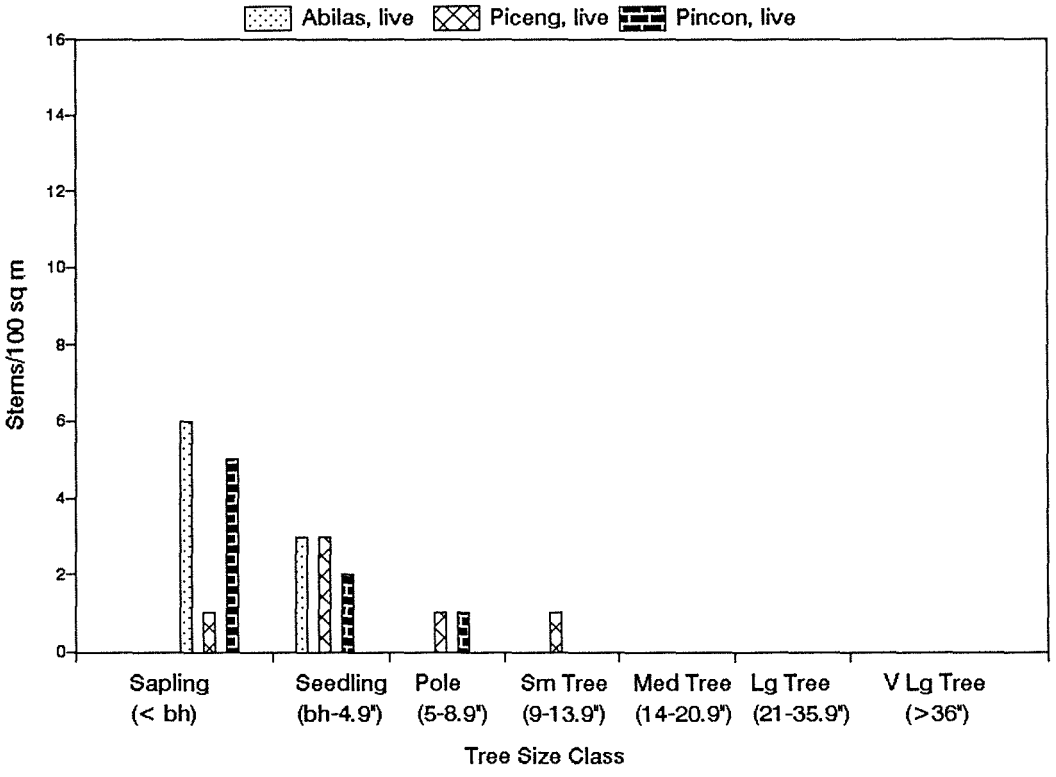

Figure II-2. Tree size class distribution on plot 311 (Picea engelmannii/Galium triflorum community).

Abilas = Abies lasiocarpa (subalpine fir)
Piceng = Picea engelmannii (Engelmann spruce)
Pincon = Pinus contorta (lodgepole pine)

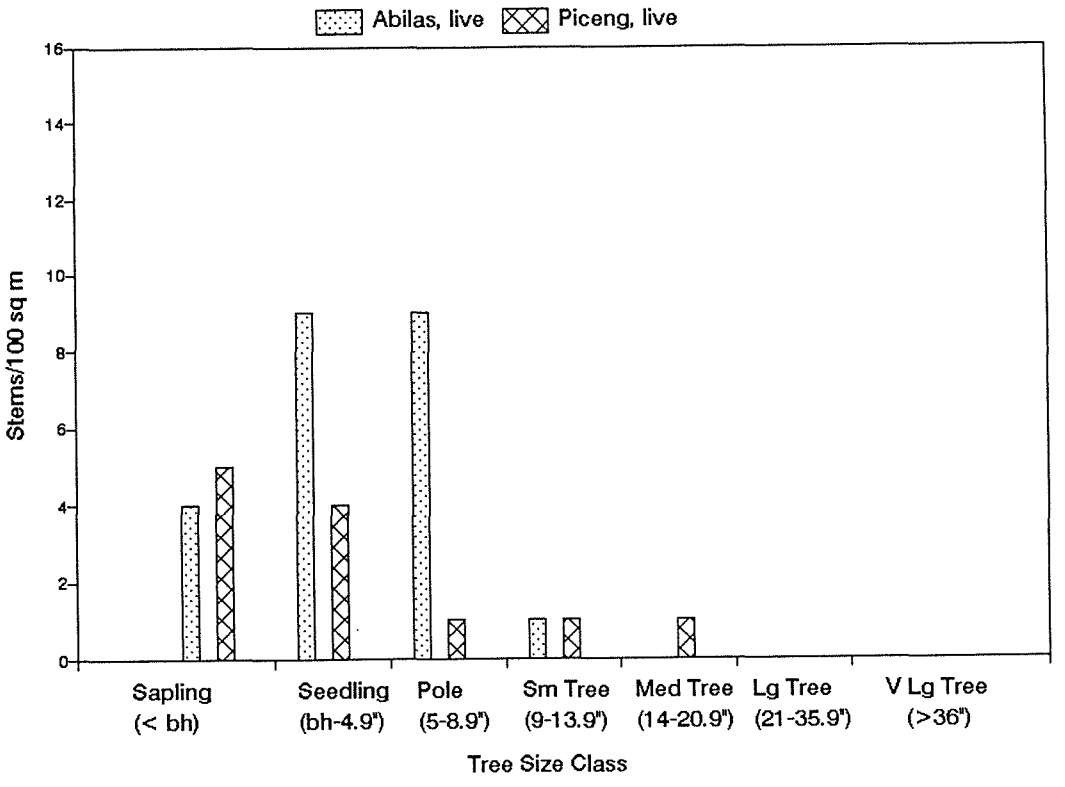

Figure II-3. Tree size-class distribution in plot 221 (Picea engelmannii/Galium triflorum community).

Abilas = Abies lasiocarpa (subalpine fir)
Piceng = Picea engelmannii (Engelmann spruce)

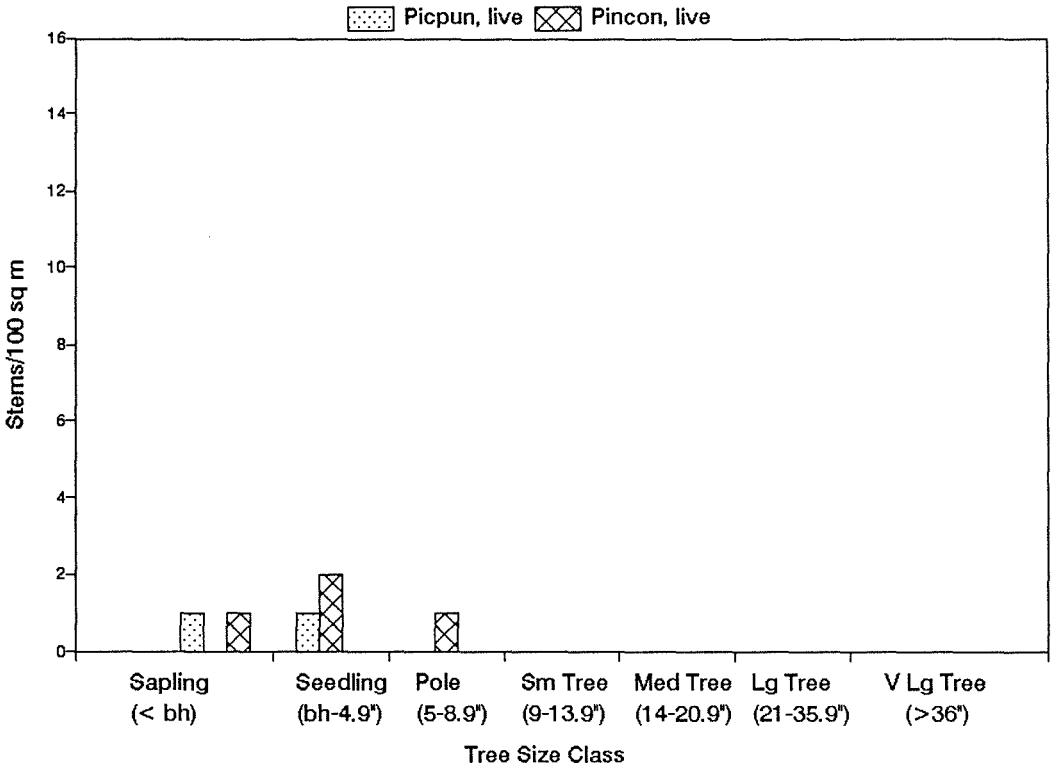

Figure II-4. Tree size-class distribution in plot 511 (Picea pungens series).

Picpun = Picea pungens (blue spruce)
Pincon = Pinus contorta (lodgepole pine)

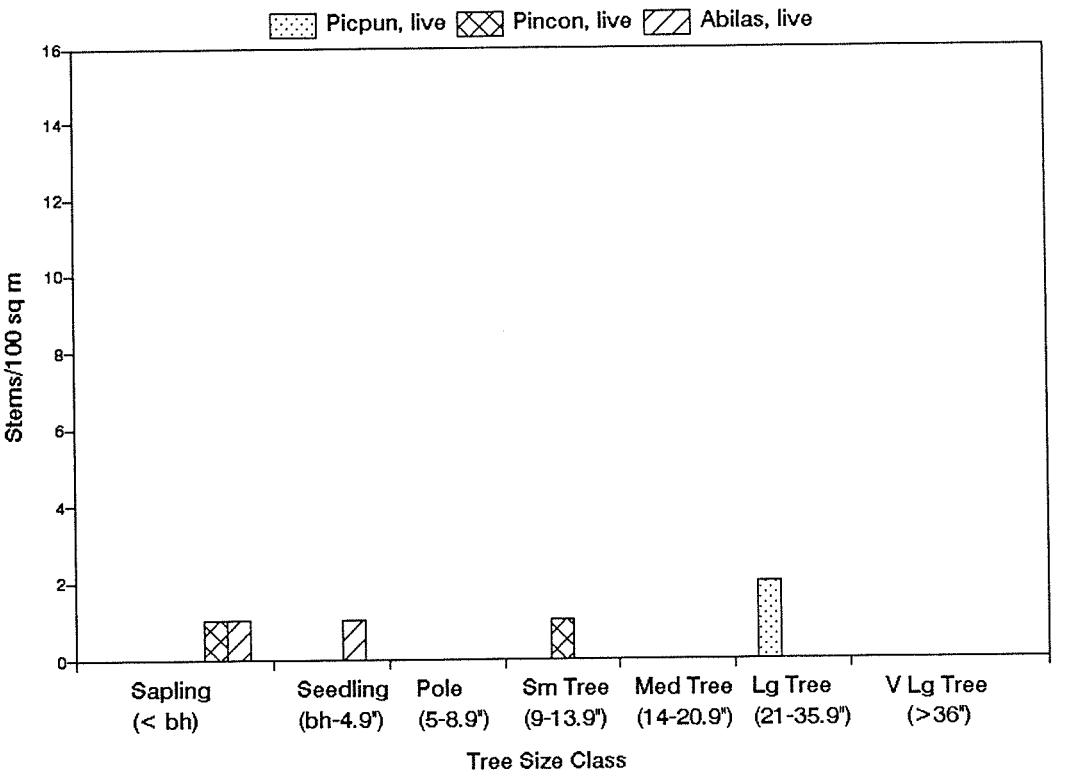

Figure II-5. Tree size-class distribution in plot 521 (Picea pungens series).

Abilas = Abies lasiocarpa (subalpine fir)
Picpun = Picea pungens (blue spruce)
Pincon = Pinus contorta (lodgepole pine)

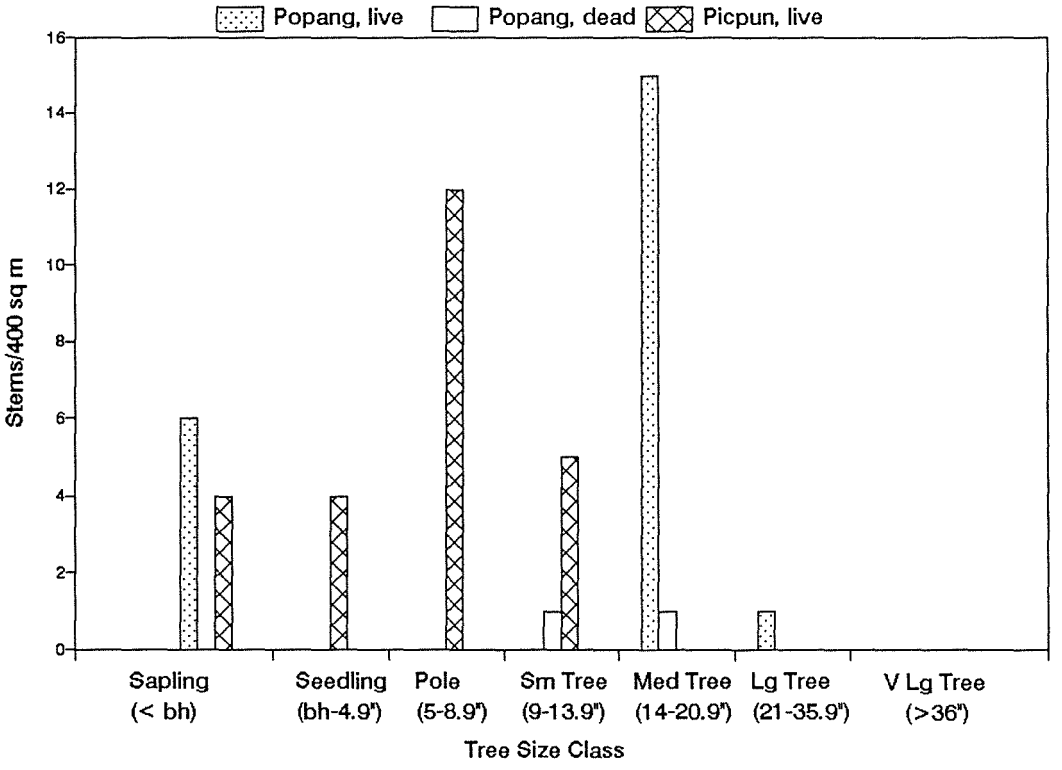

Figure II-6. Tree size-class distribution in plot 121 (Populus angustifolia/Poa pratensis community).

Picpun = Picea pungens (blue spruce)
Popang = Populus angustifolia (narrowleaf cottonwood)

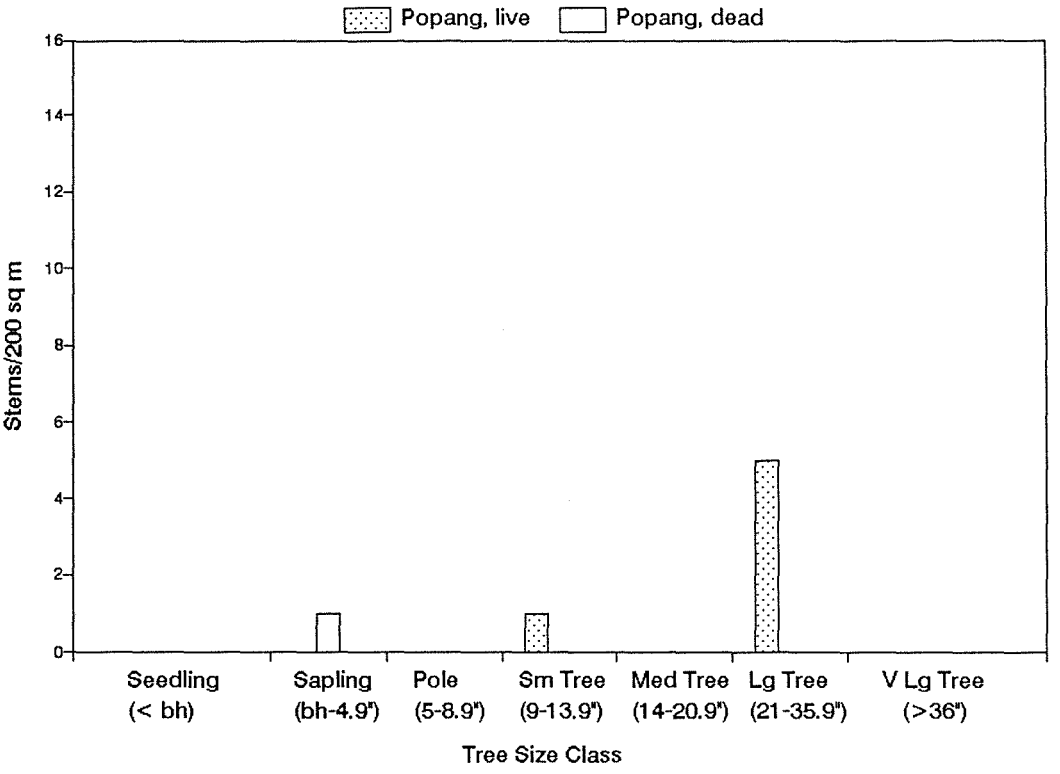

Figure II-7. Tree size-class distribution in plot 132 (Populus angustifolia/Poa pratensis community).

Popang = Populus angustifolia (narrowleaf cottonwood)

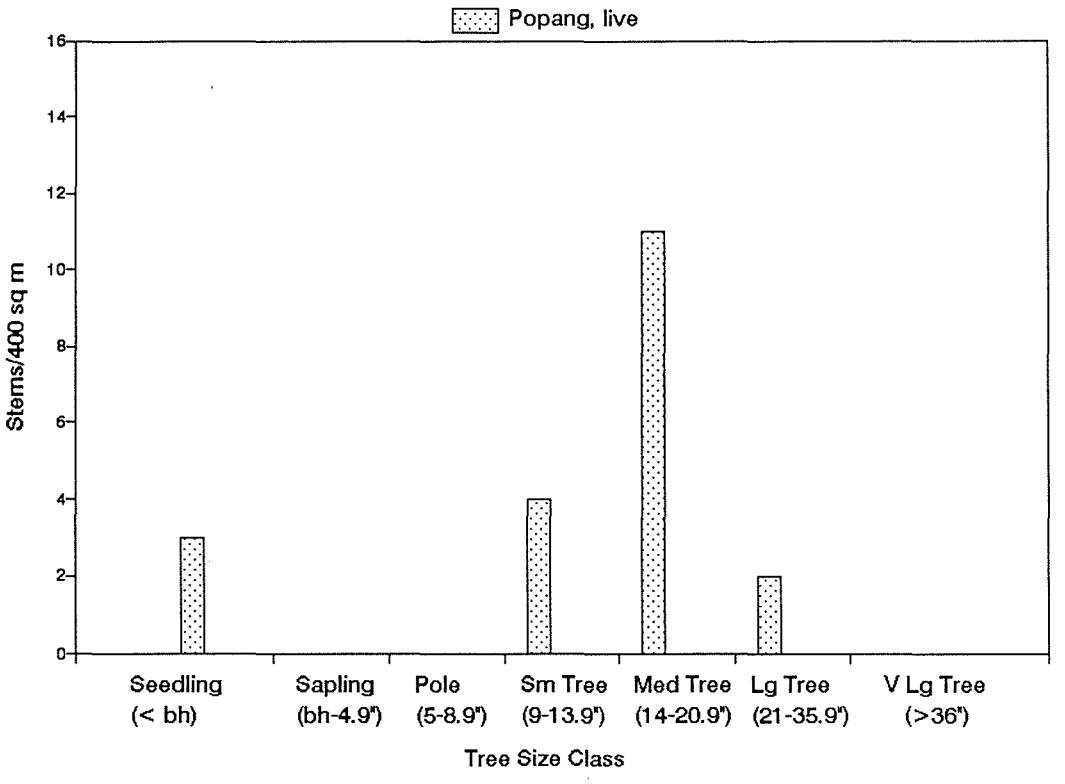

Figure II-8. Tree size-class distribution in plot 141 (Populus angustifolia/Poa pratensis community).

Popang = Populus angustifolia (narrowleaf cottonwood)

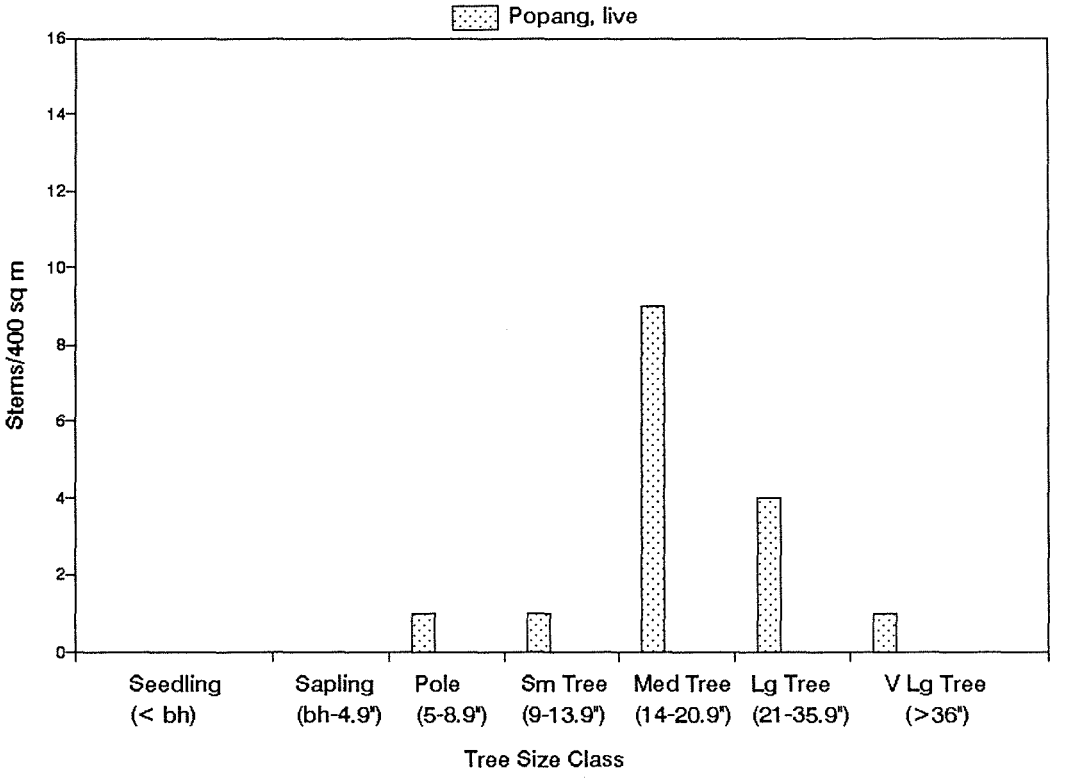

Figure II-9. Tree size-class distribution in plot 171 (Populus angustifolia/Poa pratensis community).

Popang = Populus angustifolia (narrowleaf cottonwood)

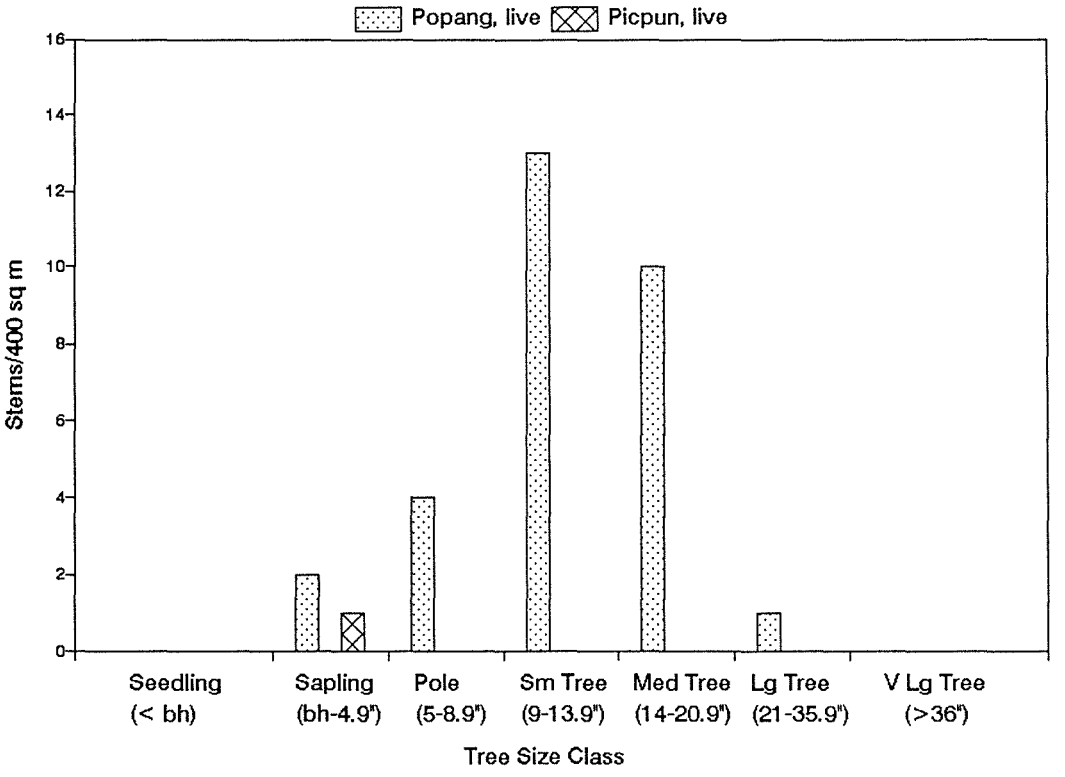

Figure II-10. Tree size-class distribution in plot 422 (Populus angustifolia/Poa pratensis community).

Picpun = Picea pungens (blue spruce)
Popang = Populus angustifolia (narrowleaf cottonwood)

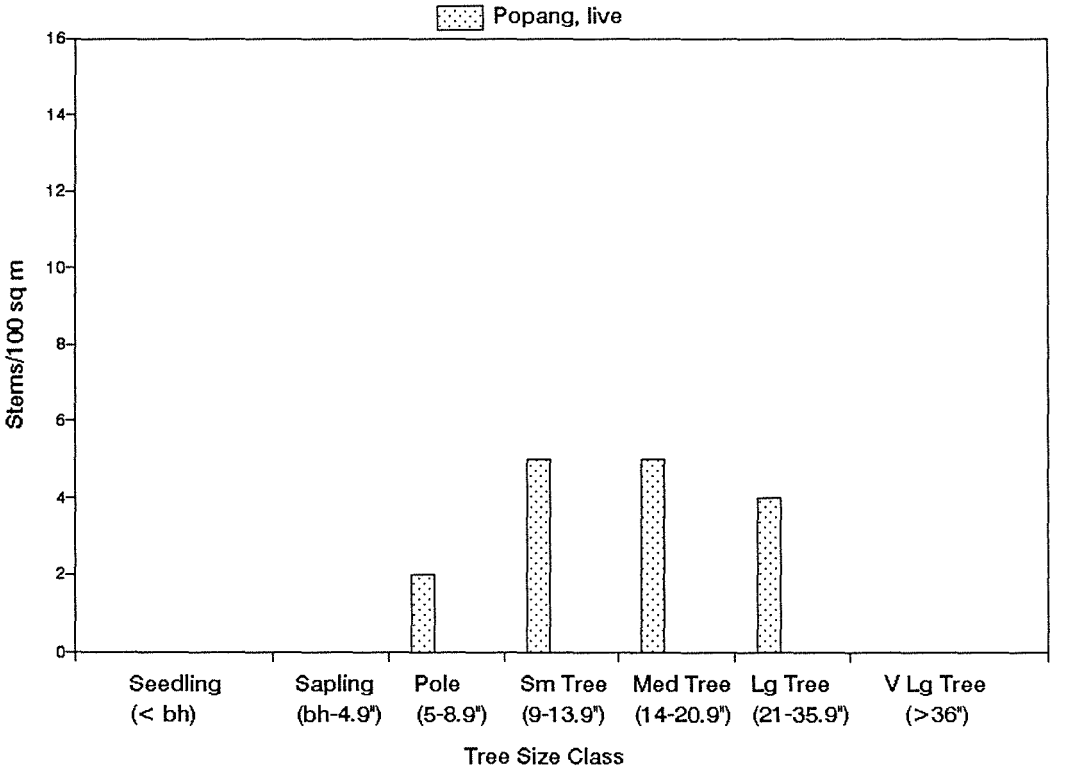

Figure II-11. Tree size-class distribution in plot 451 (Populus angustifolia/Poa pratensis community).

Popang = Populus angustifolia (narrowleaf cottonwood)

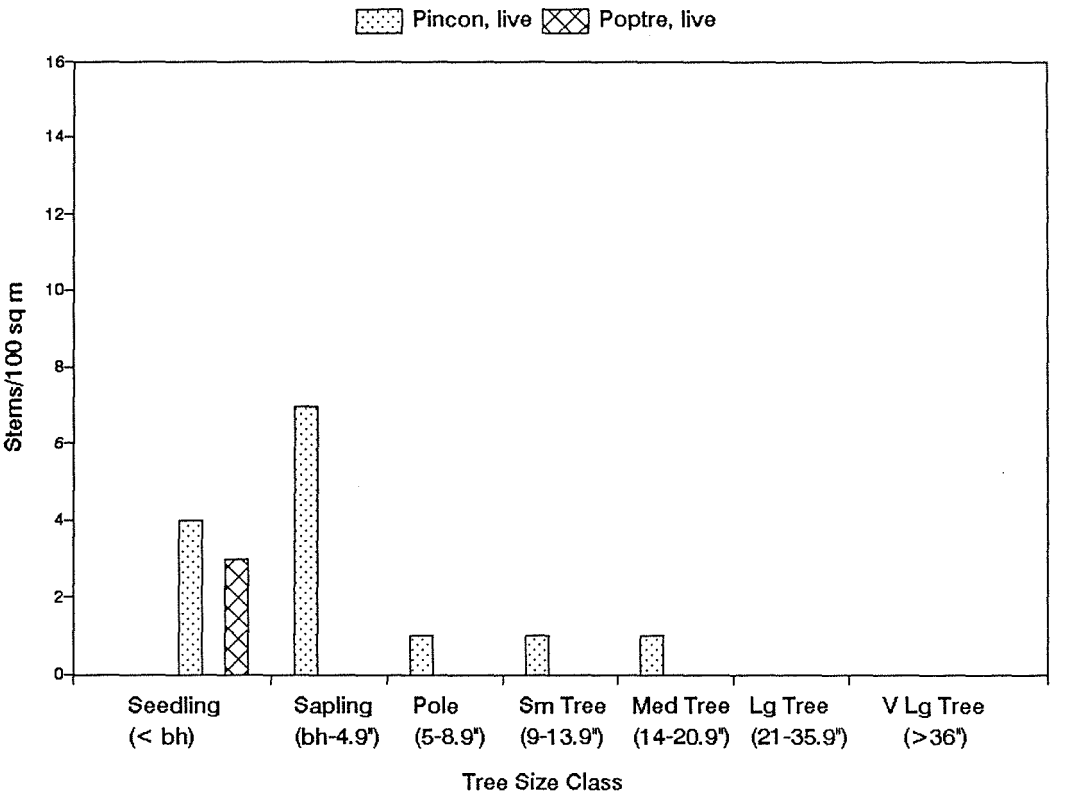

Figure II-12. Tree size-class distribution in plot 741 (Salix geyeriana/Poa pratensis community).

Pincon = Pinus contorta (lodgepole pine)
Poptre = Populus tremuloides (aspen)

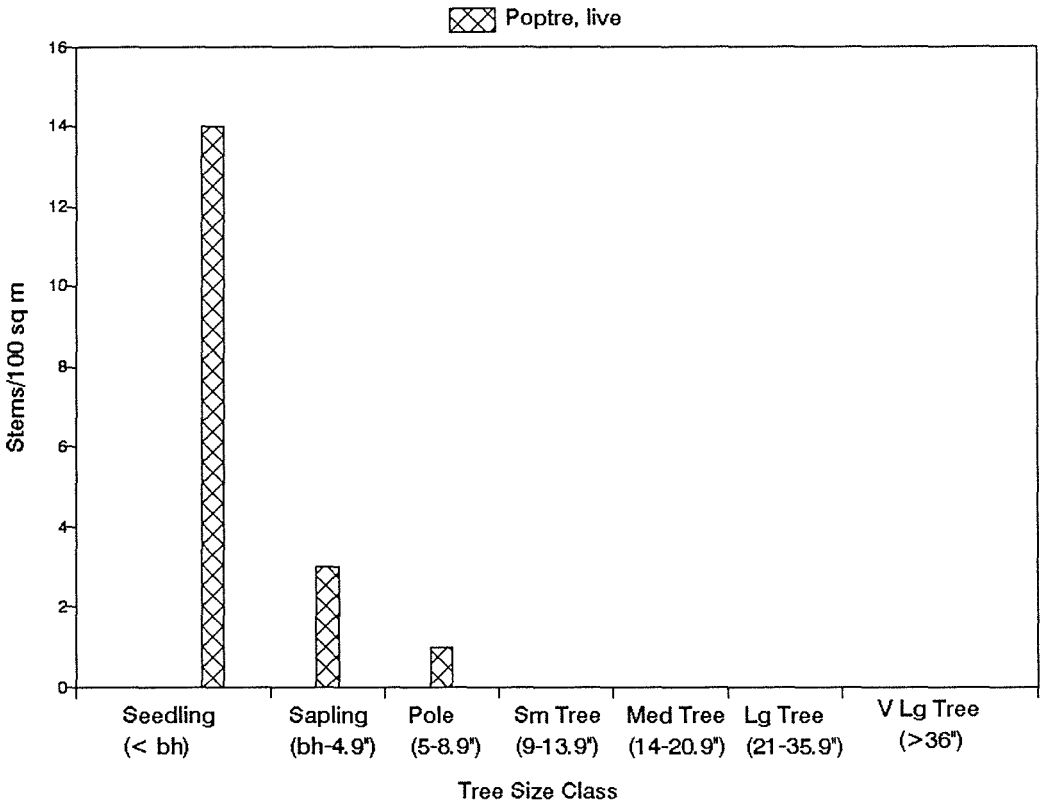

Figure II-13. Tree size-class distribution in plot 231 (other Salix geyeriana stand)

Poptre = Populus tremuloides (aspen)

Appendix IV. Scientific and common names of plant species.

Scientific Name[1]	Common Name[2]
TREES	
Abies lasiocarpa	Subalpine fir
Picea engelmannii	Engelmann spruce
Picea pungens	Blue spruce
Pinus contorta	Lodgepole pine
Populus angustifolia	Narrowleaf cottonwood
Populus tremuloides	Aspen
TALL SHRUBS	
Alnus incana var. tenuifolia	Thinleaf alder
Amelanchier alnifolia	Saskatoon serviceberry
Betula occidentalis	Water birch
Salix bebbiana	Bebb willow
Salix boothii	Booth willow
Salix exigua	Coyote willow, Sandbar willow
Salix geyeriana	Geyer willow
Salix lasiandra	Pacific willow
Salix spp.	Willow species
MEDIUM-HEIGHT SHRUBS	
Artemisia cana var. viscidulia	Mountain silver sagebrush
Artemisia tridentata	Big sagebrush
Chrysothamnus nauseosus	Rubber rabbitbrush
Chrysothamnus parryi	Parry rabbitbrush
Cornus sericea	Red-osier dogwood
Juniperus communis	Common juniper
Lonicera involucrata	Bearberry honeysuckle
Potentilla fruticosa	Shrubby cinquefoil
Ribes inerme	Whitestem currant
Ribes oxyacanthoides	Canada gooseberry
Ribes sp.	Currant
Rosa woodsii	Wood's rose
Rubus idaeus	Red raspberry
Salix planifolia ssp. planifolia var. planifolia	Planeleaf willow
Salix wolfii	Wolf willow
Shepherdia canadensis	Silver buffaloberry
Symphoricarpos occidentalis	Western snowberry
Symphoricarpos oreophilus	Mountain snowberry

LOW SHRUBS

Arctostaphylos uva-ursi	Kinnickinnick, bearberry
Mahonia repens	Oregon grape, creeping barberry
Vaccinium scoparium	Grouse whortleberry

GRAMINOIDS

Agropyron spp.	Wheatgrass
Agropyron subsecundum	Slender wheatgrass
Agropyron trachycaulum	Slender wheatgrass
Agrostis exarata	Spike bentgrass
Agrostis scabra	Rough bentgrass
Bromus anomalus	Nodding bromegrass
Bromus ciliatus	Fringed bromegrass
Bromus sp.	Bromegrass
Calamagrostis canadensis	Bluejoint reedgrass
Carex aquatilis	Water sedge
Carex aurea	Golden sedge
Carex athrostachya	Slenderbeak sedge
Carex gynocrates	Bog sedge
Carex lanuginosa	Woolly sedge
Carex microptera	Small-winged sedge
Carex pensylvanica	Penn sedge
Carex rostrata	Beaked sedge
Carex spp.	Sedge
Danthonia intermedia	Timber oatgrass, timber danthonia
Deschampsia caespitosa	Tufted hairgrass
Elymus glaucus	Blue wildrye
Elymus x macounii	Macoun wildrye
Elymus sp.	Wildrye
Festuca idahoensis	Idaho fescue
Festuca saximontana	Rocky Mountain fescue
Glyceria striata	Fowl mannagrass
Hordeum brachyantherum	Meadow barley
Juncus balticus	Baltic rush
Juncus ensifolius	Swordleaf rush
Juncus halleyi	Halley rush
Juncus longistylus	Longstyle rush
Juncus mertensianus	Merten's rush
Juncus sp.	Rush
Juncus traceyi	Tracy rush
Koeleria macrantha	Prairie junegrass
Muhlenbergia richardsonis	Mat muhly
Phleum alpinum	Alpine timothy
Phleum pratense*	Meadow timothy
Phleum sp.	Timothy
Poa interior	Inland bluegrass
Poa juncifolia	Alkali bluegrass

Poa palustris*	Fowl bluegrass
Poa pratensis*	Kentucky bluegrass
Poa sp.	Bluegrass
Stipa lettermanii	Letterman bluegrass
Stipa nelsonii	Big subalpine needlegrass
Trisetum spicatum	Spike trisetum
Trisetum wolfii	Wolf's trisetum

FORBS

Achillea millefolium	Common yarrow
Aconitum columbianum	Columbia monkshood
Actaea rubra	Red baneberry
Agoseris glauca	Pale agoseris
Allium spp.	Onion
Anaphalis margaritacea	Common pearly everlasting
Androsace filiformis	Slender rock jasmine
Androsace septentrionalis	Pygmyflower rock jasmine
Antennaria microphylla	Littlehead pussytoes
Antennaria umbrinella	Umber pussytoes
Arnica chamissonis	Chamisso arnica
Arnica mollis	Hairy arnica
Artemisia ludoviciana	Louisiana sagewort
Aster adscendens	Longleaf aster
Aster foliaceus	Leafybract aster
Aster occidentalis	Western aster
Astragalus alpinus	Alpine milkvetch
Caltha leptosepala	Elkslip marshmarigold
Campanula rotundifolia	Bluebell bellflower, hairbell
Caradmine breweri	Brewer bittercress
Cerastium arvense	Starry cerastium, meadow cerastium, mouse-ear chickweed
Cerastium fontanum	Chickweed
Cerastium nutans	Nodding cerastium
Cirsium arvense*	Canada thistle
Cirsium spp.	Thistle
Cirsium vulgare*	Bull thistle
Conioselinum scopulorum	Rocky Mountain hemlock -parsely
Descurainia incana	A tanseymustard
Dodecatheon pulchellum	Shooting star
Epilobium angustifolium	Fireweed willowherb
Epilobium brachycarpum	A willowherb
Epilobium ciliatum	A willowherb
Equisetum arvense	Field horsetail
Equisetum laevigatum	Smooth horsetail
Equisetum sp.	Horsetail
Erigeron glabellus	Smooth fleabane
Erigeron speciosus	Oregon fleabane

Erigeron ursinus	Bear River fleabane
Fragaria virginiana	Virginia strawberry
Frasera speciosa	Showy elkweed, green gentian
Galium aparine	Catchweed bedstraw
Galium boreale	Northern bedstraw
Galium trifidum	Small bedstraw
Geranium richardsonii	Richard geranium, wild white geranium
Geum aleppicum	Aleppo avens
Geum macrophyllum	Largeleaf avens
Heracleum sphondylium	Hogweed cowparsnip
Hypericum formosum	Southwestern St. Johnswort
Ligusticum porteri	Porter's lovage
Ligusticum tenuifolium	A lovage
Lupinus argenteus	Silvery lupine
Maianthemum stellatum	Starry false solomonseal
Medicago lupulina*	Black medic
Mentha arvensis	Field mint
Mertensia arizonica	Arizona bluebells
Mertensia ciliata	Mountain bluebells
Mitella pentandra	Fivestamen mitrewort
Orthilia secunda	Pyrola secunda
Osmorhiza spp.	Sweetroot
Oxypolis fendleri	Fendler cowbane
Pedicularis groenlandica	Elephanthead lousewort
Perideridia montana	Mountain yampa
Plantago major*	Common plaintain, broadleaf plaintain
Polygonum bistortoides	American bistort, American knotweed
Polygonum douglasii	Douglas bistort, Douglas knotweed
Polygonum viviparum	Viviparous bistort viviparous knotweed
Potentilla anserina	Silverweed cinquefoil
Potentilla diversifolia	Blueleaf cinquefoil
Potentilla gracilis	Northwest cinquefoil
Prunella vulgaris	Common selfheal
Ranunculus spp.	Buttercup
Rudbeckia laciniata	Cutleaf coneflower
Rumex crispus*	Curly dock
Saxifraga odontoloma	Washington saxifrage
Senecio triangularis	Arrowleaf groundsel
Sidalcea neomexicana	New Mexico checkermallow
Solidago canadensis	Canada goldenrod
Solidago gigantea	Giant goldenrod
Solidago multiradiata	A goldenrod
Stellaria borealis	Northern starwort
Taraxacum officinale*	Common dandelion
Thalictrum fendleri	Fendler meadowrue

Thalictrum sparsiflorum	Few-flowered meadowrue
Thalspi arvense*	Field pennycress
Tragopogon dubius*	Yellow salsify
Trifolium longipes	Longstalk clover
Trifolium pratense*	Red clover
Trifolium repens*	White clover
Trollius laxus	Globeflower
Urtica dioica	Stinging nettle
Veronica wormskjoldii	A speedwell
Veronica serpyllifolia	Thymeleaf speedwell
Vicia americana	American vetch
Viola sp.	A violet

* Exotic species

(1) Scientific names largely follow:

Dorn, R. 1988. Vascular plants of Wyoming. Mountain West Publishing, Cheyenne, WY.

(2) Common names largely follow:

Beetle, A. A. 1970. Recommended plant names. Research Journal 31, Agricultural Experiment Station, University of Wyoming, Laramie, WY.

Appendix V. Key to riparian vegetation types

KEY TO RIPARIAN VEGETATION TYPES

1a. Tree overstory cover ≥ 25%. 2.
  2a. The tree canopy contains mainly conifers, or about equal amounts of conifers and deciduous trees.
Group A: Coniferous tree types
  2b. The tree canopy contains mainly deciduous trees; conifers are minor or absent.
Group B: Deciduous tree types
1b. Tree overstory cover < 25%.....3
  3a. Tall shrubs (> 1.5m tall; Salix geyeriana, S. boothii, S. lasiandra, Alnus incana) contribute ≥ 25% cover.
Group C: Tall shrub types
  3b. Tall shrubs contribute < 25% cover.....4
    4a. Medium shrubs (< 1.5m tall; Salix wolfii, Artemisia cana) or tree seedlings or saplings contribute ≥ 25% cover.
Group D: Medium shrub types
    4b. Medium shrubs or tree seedlings or saplings contribute <25% cover.
Group E: Herbaceous types

Group A: Coniferous tree types
1a. Picea engelmannii contributes at least 25% of the tree canopy, which may consist mainly of Abies lasiocarpa or Pinus contorta. Picea pungens is absent or contributes little cover (Picea engelmannii series).
Only one type has been identified so far:
Picea engelmannii/Galium triflorum community
1b. Picea pungens contributes ≥ 50% of the tree canopy, which may consist mainly of Pinus contorta.
Picea pungens series

Group B: Deciduous tree types
Only one series has been identified so far:
Populus angustifolia contributes ≥ 50% of the tree canopy.
Populus angustifolia series

Group C: Tall shrub types
1a. Willows (genus Salix) contribute most of the canopy cover.....2
  2a. Salix geyeriana or Salix lasiandra, alone or in combination, contribute ≥ 50% of the canopy cover (Salix geyeriana series).....3
    3a. Carex rostrata contributes ≥ 20% cover to the understory.
S. geyeriana/Carex rostrata community
    3b. Carex rostrata contributes < 20% cover to the understory.....4

4a. Poa pratensis dominates or codominates the understory.
S. geyeriana/Poa pratensis community
4b. Poa pratensis contributes little cover.
Other S. geyeriana stands

2b. Salix boothii contributes ≥50% of the canopy cover; Salix geyeriana and Salix lasiandra are absent or clearly contribute less cover than S. boothii. **(Salix boothii series)**.....5
5a. Poa pratensis dominates or codominates the understory.
S. boothii/Poa pratensis community
5b. Poa pratensis is a minor species.
Other S. boothii stands

1b. Tall shrubs other than willows contribute most of the canopy cover; Alnus incana contributes ≥ 50% of the canopy cover (Alnus incana series).....6

6a. Glyceria striata, Poa pratensis, Phleum pratense, or other graminoids of mesic sites dominate the understory.
A. incana/Mesic Graminoid community
6b. Graminoids of mesic sites are minor components of the understory.
Other Alnus incana stands

Group D: Medium shrub types

1a. Tree seedlings or saplings dominate or codominate the medium shrub layer.
Only one type has been identified so far:
Populus angustifolia/Recent Alluvial Bar community
1b. Medium-height shrubs dominate the medium shrub layer; tree seedlings and saplings are absent or minor components.....2

2a. Artemisia cana contributes ≥ 50% of the shrub canopy (Artemisia cana series).
Only one community has been identified so far:
Poa pratensis dominates or codominates the understory.
A. cana/Poa pratensis community
2b. Artemisia cana contributes < 50% of the shrub canopy; other shrub species form the canopy.
Only one type has been identified so far:
Salix wolfii contributes ≥ 50% of the canopy cover (Salix wolfii series); Deschampsia caespitosa contributes ≥ 5% of the understory cover.
Salix wolfii/Deschampsia caespitosa community

Group E: Herbaceous types

1a. Graminoids (grasses, sedges, and rushes) contribute most of the cover; forbs are minor.....2

2a. Sedges (genus Carex) contribute ≥ 50% of the cover.....3

3a. Carex microptera contributes ≥ 25% cover.

Carex microptera community

3b. Carex microptera contributes < 25% cover.....4

4a. Carex rostrata contributes ≥ 25% cover.

Carex rostrata community

4b. Carex rostrata contributes < 25% cover.

Only one type has been identified so far:

Carex aquatilis contributes ≥ 25% cover.

Carex aquatilis community

2b. Sedges contribute < 50% of the cover

Only one type has been identifiedso far:

Juncus balticus contributes ≥ 25% cover.

Juncus balticus community